KOÇ UNIVERSITY

GRADUATE SCHOOL OF SOCIAL SCIENCES & HUMANITIES

PERFORMANCE EVALUATION OF TURKISH PENSION FUNDS: SELECTIVITY, MARKET TIMING AND PERSISTENCE

MASTER'S THESIS

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Abstract

In this study, we evaluate performances of Turkish pension funds in terms of security selection and market timing abilities. Furthermore, we measure persistence in performance. We find Turkish pension funds, in the aggregate, have not been able to outperform the market. The results are consistent with the efficient markets hypothesis. Out of 65 funds analyzed, only 2 funds have shown significant macro-forecasting skills and 17 funds have displayed perverse market timing. The persistence tests reveal that pension funds, in general, do not have performance persistence in the medium-term. However, we find strong evidence of persistence in the short-term.

Keywords: *Performance evaluation, security selection, market timing, performance persistence.*

Özet

Bu çalışmada, Türk emeklilik fonlarının performansları seçicilik ve piyasa zamanlaması kriterleri bağlamında değerlendirilmiştir. Ayrıca, fonların performans devamlılığı da incelenmiştir. Çalışma sonucunda, Türk emeklilik fonlarının genel olarak piyasadan daha kötü performans sergilediği tespit edilmiştir. Sonuçlar, etkin piyasalar hipotezini destekler niteliktedir. İncelenen 65 fondan sadece 2'si başarılı piyasa zamanlaması gösterirken 17 fonun negatif zamanlama performansı sergilediği görülmüştür. Performans devamlılığı testleri sonucunda, genellikle emeklilik fonlarının orta vadede performans devamlılığına sahip olmadığı gözlemlenmiştir. Bununla birlikte, sonuçlar emeklilik fonlarının kısa vadede performans devamlılığı gösterdiği görüşünü güçlü şekilde desteklemektedir.

Anahtar Sözcükler: *Performans değerlendirmesi, seçicilik, piyasa zamanlaması, performans devamlılığı.*

Table of Contents

List of Tables

List of Figures

1.Introduction

The Individual Pension System in Turkey has shown a significant progress in recent years. Since it was first established in late 2003, the number of investors and the total net asset value of private pension funds have been increasing. This system is new and not saturated yet, hence it has a bright future with significant growth potential. In 2011, the number of participants has grown around 16% and exceeded 2.5 million when compared to the end of 2010. In the same period, the total net asset value of the pension funds has increased by 19% and exceeded TL 14 billion while mutual funds operating in Turkish capital markets suffered from losses in their portfolio values.[1] Therefore, the performances of Turkish pension funds offer an interesting environment for research.

A performance evaluation of Turkish pension funds is also very important for investors. Investors have been shifting from mutual funds to pension funds in recent years. A rational investor chooses the funds with the highest rate of return given the level of risk he is willing to take. Hence, the risk is a very crucial phenomenon in performance evaluation. In this thesis, we find risk-adjusted returns to evaluate the performances of 65 actively managed Turkish pension funds. We aim to answer the following questions:

1. Do Turkish pension funds outperform their benchmarks? (Is the shift of investors from mutual funds to pension funds in Turkey rational?)
2. Do the fund managers possess market timing skills?
3. Do the performances of pension funds show persistence?

We use a unique sample, acquired from Forex database, to implement the analyses of security selection abilities, market timing and persistence. Our sample is relatively free of survivorship bias since it includes returns of pension funds that do not operate currently or that were merged with other funds in recent years. Some earlier studies like Karatepe and Gökgöz (2007) and

[1] See Pension Monitoring Center, Individual Pension System 2011 Progress Report, p.16.

Korkmaz and Uygurtürk (2007, 2008) do not take survivorship bias into account in their evaluations of performances of Turkish pension or mutual funds. However, in the presence of survivorship bias, the performance evaluation results are likely to capture an incorrect picture of the mutual or pension fund industry. Hence, evaluating the performances of Turkish pension funds with a relatively less survivorship-affected sample must be considered as a contribution of this study to the existing literature.

We group the pension funds in the sample into six categories according to their portfolio structures and investment strategies. The groups are money market funds, fixed income funds, balanced funds, flexible funds, equity funds and eurobond funds. More information about these groups is given in Section 4. For each group, we establish weighted portfolios using market values of the funds. In the performance analysis, in addition to evaluating the performances at the individual fund level, we also measure security selection and market timing abilities of these value weighted portfolios.

To measure the security selection abilities, we employ a single-factor model (CAPM security market line model) and a multi-factor model. Also, we estimate an extension of Henriksson and Merton's (1981) model to measure market timing ability of pension fund managers. We add a new term to our multi-factor model and this term takes the maximum of a sample comprising excess returns of the benchmarks and zero. A perfect market timer will allocate all his portfolio holdings to the asset class which yields the highest return. If no asset class generates a positive excess return, the perfect market timer will sell his portfolio and invest in the risk free asset. In this way, he will obtain an excess return of at least zero.

To investigate the persistence in pension funds' performances, we employ various tests. First, we calculate up to 12^{th} order autocorrelations to see any evidence of a significant pattern and to account for any effects of seasonality. Next, we test persistence more directly by implementing a Winner-Loser test. Following Malkiel (1995) and Christensen (2005), we divide our sample period into three sub-periods. In each sub-period, we determine "winner" funds and "loser" funds. If a fund yields a return which is equal to or higher than the median return in its group, it is labeled as a "winner" fund. Otherwise, it is considered as a "loser" fund. By determining winners and losers in each sub-period, we form two-way tables and calculate a simple χ^2 independence test statistic and a log-odds-ratio. A detailed explanation of log-odds-ratio is provided in Section 5. In order to confirm the robustness of our conclusions based on the Winner-Loser test, we carry out cross-sectional regressions. Again, we divide our sample period into three sub-periods and calculate each fund's return in each sub-period. Then, we regress funds' returns in the current sub-period onto the returns from the previous sub-period to see whether returns from the past have an explanatory power on current returns. Lastly, we adopt a time-series approach to measure the short-term persistence, i.e., hot-hands phenomenon. We construct equally-weighted portfolios of top-performing funds and worst performing funds in each group. Each portfolio is rebalanced monthly. Then, we run our multi-factor regression model with returns of best-performing and worst-performing portfolios. Due to the small number of funds in the balanced funds group, we treat balanced and flexible funds as a single category for this test. As a result, we have five groups and ten portfolios in this approach. This means we run ten time-series regressions in order to analyze the effectiveness of a strategy that updates the investor's portfolio each month so that it comprises only the best or worst performing funds of the previous month.

The remainder of this thesis is organized as follows. In the next section, we explain the Individual Retirement System in Turkey and present descriptive statistics. Section 3 provides a literature review. In Section 4, we describe our sample and explain the assumptions used in the analysis. This section also discusses the survivorship bias and its importance for performance evaluation studies. Also, benchmarks used in the time-series regressions are discussed here. Section 5 presents the theory and methodology. In this section, we first discuss the efficient market hypothesis and the CAPM. Then, single- and multi-factor models for evaluating security selection abilities, the option-based regression approach for measuring market timing skills and various tools employed to analyze the persistence are presented. In Section 6, we discuss the empirical results and Section 7 concludes.

2. The Individual Pension System in Turkey

The Individual Pension Savings and Investment System Law was adopted in the Turkish National Assembly on March 28, 2001 and published in the Official Gazette no. 24366 on April 7, 2001. This law is a part of the social security reform and aims to complement the public pension system. The Individual Pension System was officially commenced on October 27, 2003 after pension companies were granted licenses and started to offer pension products.[2]

The main properties of the Individual Retirement system can be pointed out as following.

- The system is supplementary to the existing state pension plans.
- The system is voluntary and based on defined contribution plans.
- The contributions collected from the individuals are transmitted to pension funds which are established as mutual funds. (In the rest of this thesis, pension funds will be regarded as another type of mutual funds.)
- Anybody who is able to use his civil rights can enter the system.
- Only pension companies can establish the pension funds. These companies can be established with permission of Undersecretariat of Treasury. They need an initial capital of TL 20 million for establishment. Half of this amount should be paid in cash when the company begins to operate.
- At least 3 different funds with different portfolio structures must be established. In this way, participants can choose a fund according to their risk and return preferences.
- Both employees and employers as well as individuals can make contributions to the pension funds.
- The rights of the investors are portable and accumulations can be transferred into another retirement company.
- At retirement, the investors can take their accumulations as lump sum or they can withdraw the accumulations partially. They will have an option in either buying an annuity from an insurance company or leaving the money in the funds to be invested. Retirement age is 56 providing that, people make contributions to the fund for at least 10 years.

[2] See Pension Monitoring Center, Individual Pension System 2004 Progress Report, p.21.

- Pension funds are managed professionally by the pension companies established within the Capital Markets Law.
- The assets of a fund can be deposited in a custodian bank which will be approved by the Capital Markets Board of Turkey. The custodian that is selected by the pension company and approved by the Capital Markets Board can be a bank which operates in accordance with the Law on Banking.
- The system is coordinated by Advisory Board. The regulations can be made by relevant institutions, the Undersecretariat of Treasury and the Capital Markets Board of Turkey.
- Contributions are tax deductible up to ten percent of income with a cap of annual minimum wage. In investment stage, there is not any withholding tax on earnings of the private pension funds. When the participant has contributed for more than ten years and is 56 or older, 25 percent of the benefit payment of a lump sum pension is tax free and the remaining part is subject to a withholding tax of five percent.[3]

2.1. Importance of the Individual Pension System for Financial Stability and Social Welfare

The Individual Pension System increases the well-being of future generations. Participants have a higher welfare level with the additional pension income during their retirement years. This system stimulates the economic growth by providing resources for infrastructure and long-term investments increasing the employment.[4] It also has a positive impact on financial stability because of the volume and maturity structure of the funds collected. The funds collected in the Individual Pension System increases savings in the country. The savings of households in Turkey is still not at its desired level. However, since it was first started in 2003, the amount of contributions to the Individual Pension System has been increasing steadily. Likewise, the share of private pension funds in household financial assets has increased significantly during the recent period. Private pension funds which had 1.5% share in household financial assets in 2007, grew by 207% in nominal terms rising their share to 2.6% by September 2011 as a result of increasing participation to the system and regular contributions. With the accumulation of small

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[3] More information on the main properties of The Individual Pension System can be found at Central Bank of the Republic of Turkey, Financial Stability Report, November 2011, 13, p.54 and Capital Markets Board of Turkey, <http://www.cmb.gov.tr/indexpage.aspx?pageid=23&submenuheader=4>, (26.06.2012).

[4] See Pension Monitoring Center, Individual Pension System 2004 Progress Report, p.22.

savings from individuals, financial development and deepening can be achieved. Providing resources for private and public investments helps decrease interest rates and increase borrowing opportunities. Additionally, pension funds make long term investments rather than seeking short-term profits. This increases longer term institutional investments limiting fluctuations and speculations caused by short-term capital flows, strengthens capital markets against financial crises and helps financial stability. In addition to supporting production growth and employment and maintaining stable economic growth, rising volume in savings helps reduce inflation due to the fall in consumption.[5]

Increased borrowing opportunities for longer time periods with low interest rates leads to a reduction in the budget deficit and borrowing needs in public sector as a result of a decrease in social security expenses. Indeed, during the period between 2004 and 2011, public debt securities have become the most preferred asset class by private pension funds, which means the large portion of the funds accumulated in the system is transferred to the public sector. In addition, the increased funding resources in private sector raise issuance of securities and investments distributing risks among investors.[6]

2.2. Pension Companies

As of June 2012, there are 15 pension companies operating in the Individual Pension System in Turkey.[7] However, only four companies seem to be the major players. More than half of the participants choose Anadolu Hayat Emeklilik A.Ş., Avivasa Emeklilik ve Hayat A.Ş., Garanti Emeklilik ve Hayat A.Ş. or Yapı Kredi Emeklilik A.Ş.. As of 15 June 2012, the number of investors in these four companies is 1,950,453 while the total number of investors in the

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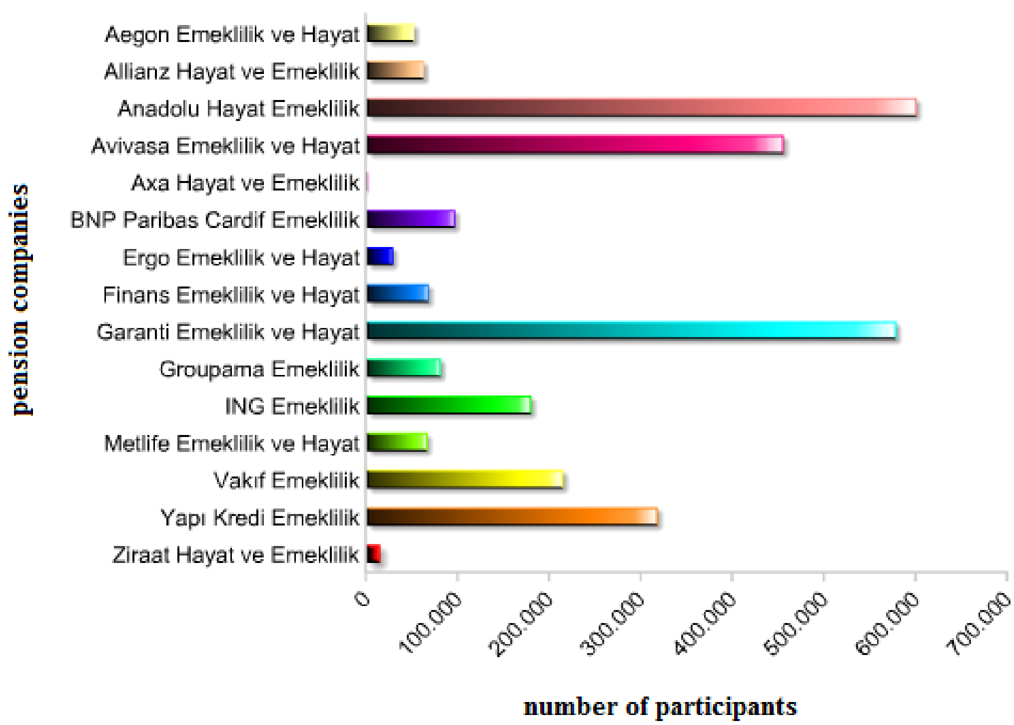
[5] See Central Bank of the Republic of Turkey, Financial Stability Report, November 2011, 13, p.53-56.

[6] See Central Bank of the Republic of Turkey, Financial Stability Report, November 2011, 13, p.55-56.

[7] As of June 2012, pension companies operating in the Individual Retirement System are Aegon Emeklilik ve Hayat A.Ş., Allianz Hayat ve Emeklilik A.Ş., Anadolu Hayat Emeklilik A.Ş., Avivasa Emeklilik ve Hayat A.Ş., BNP Paribas Cardif Emeklilik A.Ş., Deniz Emeklilik ve Hayat A.Ş., Ergo Emeklilik ve Hayat A.Ş., Finans Emeklilik ve Hayat A.Ş., Garanti Emeklilik ve Hayat A.Ş., Groupama Emeklilik A.Ş., Ing Emeklilik A.Ş., Vakıf Emeklilik A.Ş., Yapı Kredi Emeklilik A.Ş. and Ziraat Hayat ve Emeklilik A.Ş.

Individual Pension System is 2,812,563. These four big pension companies are followed by Vakıf Emeklilik A.Ş., ING Emeklilik A.Ş., BNP Paribas Cardif Emeklilik A.Ş. and Groupama Emeklilik A.Ş.. The total number of participants in the rest of the pension companies (Aegon Emeklilik ve Hayat A.Ş., Allianz Hayat ve Emeklilik A.Ş., Axa Hayat ve Emeklilik A.Ş., Ergo Emeklilik ve Hayat A.Ş., Finans Emeklilik ve Hayat A.Ş., Metlife Emeklilik ve Hayat A.Ş. and Ziraat Hayat ve Emeklilik A.Ş.) is less than the number of participants in Garanti Emeklilik ve Hayat A.Ş. which is 577,873. Axa Hayat ve Emeklilik A.Ş. has the lowest number of participants which is only 852.[8] Figure 2.1 shows the number of investors in each pension company in the Individual Pension System.

Figure 2.1: The number of investors in pension companies as of 15 June 2012



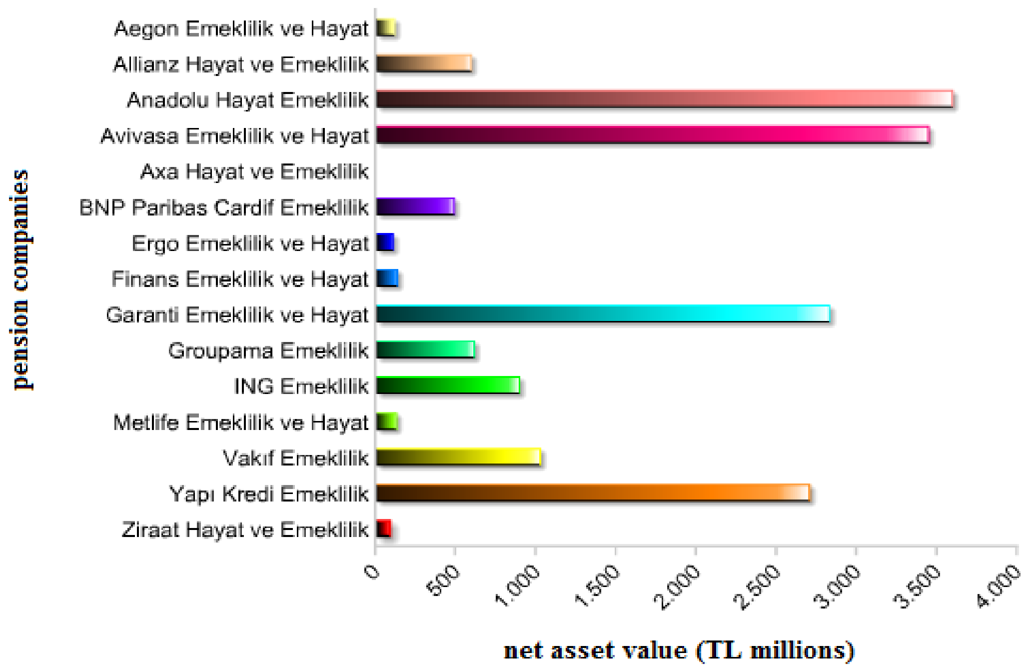
Pension Monitoring Center, http://www.egm.org.tr/weblink/BESgostergeler.htm

The total net asset value in Turkish private pension funds was around TL 288 million at the end of 2004 and the amount of contributions to the system has been increasing steadily throughout

[8] See Pension Monitoring Center, http://web2.egm.org.tr/webegm2/chart/besgosterge/wg_sirketview_tablolu.asp?raportip=10 (27.06.2012).

the years. In June 2012, the total net asset value of the Turkish private pension funds amounted to more than TL 16.8 billion. The net asset value of Anadolu Hayat Emeklilik A.Ş., Avivasa Emeklilik ve Hayat A.Ş., Garanti Emeklilik ve Hayat A.Ş. and Yapı Kredi Emeklilik A.Ş is more than TL 12 billion. These four pension companies are followed by Vakıf Emeklilik A.Ş., ING Emeklilik A.Ş., BNP Paribas Cardif Emeklilik A.Ş., Groupama Emeklilik A.Ş. and Allianz Hayat ve Emeklilik A.Ş., while Aegon Emeklilik ve Hayat A.Ş., Ergo Emeklilik ve Hayat A.Ş., Finans Emeklilik ve Hayat A.Ş., Metlife Emeklilik ve Hayat A.Ş., Ziraat Hayat ve Emeklilik A.Ş. and Axa Hayat ve Emeklilik A.Ş. do not have significant shares in the total net asset value of the private pension companies. As of 15 June 2012, Anadolu Hayat Emeklilik A.Ş. has the highest net asset value of TL 3,598,728,283. On the other hand, Axa Hayat ve Emeklilik A.Ş. has the lowest net asset value which is TL 1,206,594.[9] Figure 2.2 presents net asset values of 15 pension companies in the Individual Pension System.

Figure 2.2: Net asset values of pension companies as of 15 June 2012.



Pension Monitoring Center, http://www.egm.org.tr/weblink/BESgostergeler.htm

[9] See Pension Monitoring Center, http://web2.egm.org.tr/webegm2/chart/besgosterge/wg_sirketview_tablolu.asp?raportip=10 (27.06.2012).

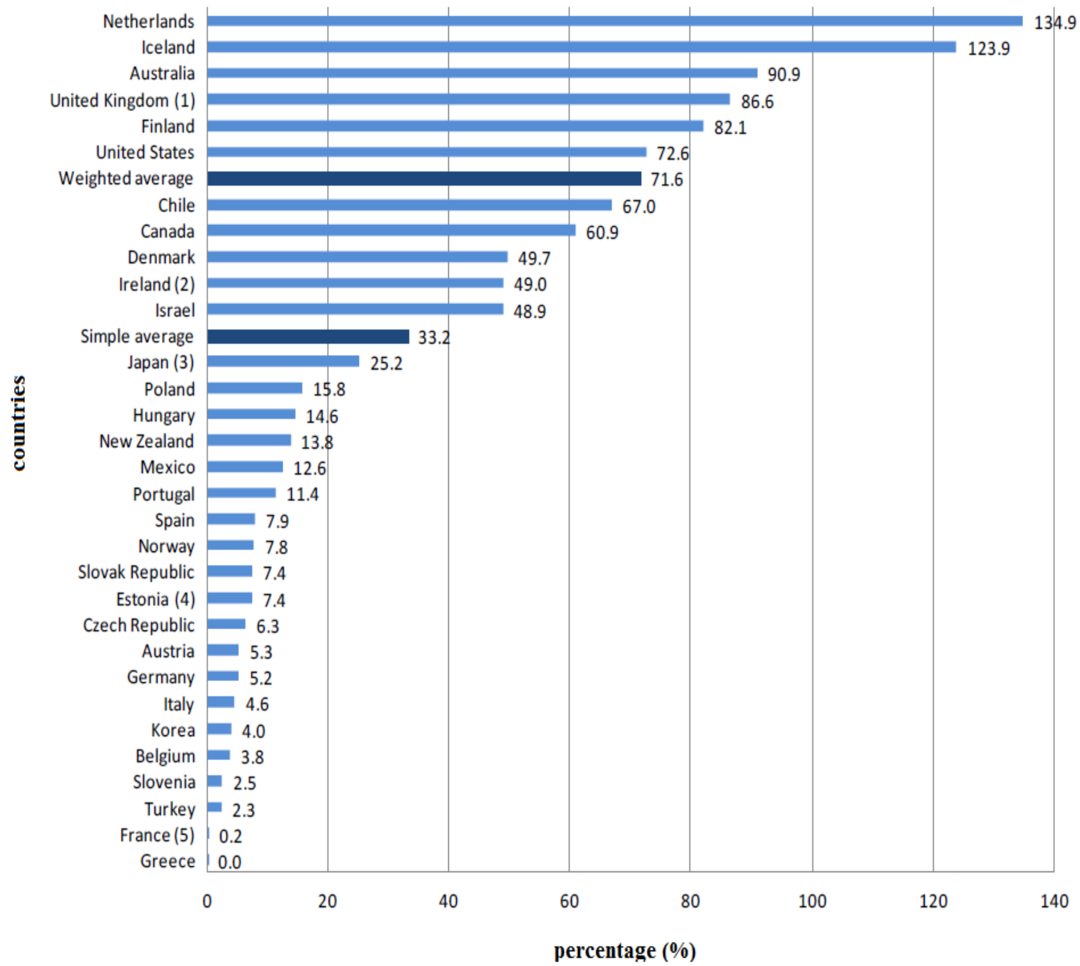
2.3. The Future of the Individual Pension System

Even though the Individual Pension System is recently established, it has showed a significant progress. Moreover, the system still continues its stable growth and is not mature yet. In 2011, total fund value increased by 19% and reached TL 14.3 billion and the number of participants rose by 16% exceeding 2.5 million.[10] Even during the global financial crisis of 2008, the number of participants and contributions to the pension funds continued to increase. The Individual Pension System is thought to have a high growth potential. There are a number of reasons behind this view.

First of all, the system is recently introduced and it is still developing. Secondly, the majority of the participants belong to the age group 25-34. Also, since the system is not mature and saturated yet, a big portion of the participants are currently contributing to and not benefitting from the system. In addition, pension companies make efforts to promote the Individual Pension System and savings to meet the borrowing demands of public and private sector investments which have been significantly rising in recent years. Moreover, the ratio of total fund value of private pension funds in Turkey to GDP is lower than many other countries with developed private pension systems. Figure 2.3 shows the ratios of total fund value of the private pension systems to GDP in selected OECD countries.

[10] See Pension Monitoring Center, Individual Pension System 2011 Progress Report, p.16.

Figure 2.3: Ratio of total net asset value of the private pension systems to GDP in selected OECD countries.



OECD, Pension Markets in Focus, July 2011, 8, p.7

As can be seen in Figure 2.3, total net asset values of private pensions in The Netherlands and Iceland are higher than their GDPs. The Netherlands has a net asset value-to-GDP ratio of 134.9%, while Iceland has a ratio of 123.9%. These two countries are followed by Australia, The United Kingdom, Finland and The United States each having a net asset value-to-GDP ratio of 70% or higher. In the 30%-70% range, we see Chile, Canada, Denmark, Ireland and Israel. Turkey has a ratio of 2.3% which is only higher than France and Greece. The small net asset value-to-GDP ratio of Turkey can be interpreted to be an important indicator for the growth potential of the Individual Pension System.

Moreover, in the recent period, Turkish pension funds have been more successful in generating high real and net returns. Table 2.1 shows that over the period 2008-2010, average annual returns of private pension funds in Turkey have been 16.5% in nominal terms and 7.5% in real terms. The closest country to Turkey is Denmark which has nominal and real average annual returns of 6.8% and 4.3%, respectively. An interesting observation is that only six countries (Turkey, Denmark, Mexico, Germany, The Netherlands and Norway) have positive average annual real returns in the post-crisis period between 2008 and 2010. In this period, the simple average of the real annual returns of the selected OECD countries in Table 2.1 is -1.1%.

Table 2.1: Pension fund nominal and real 3-year average annual returns in selected OECD countries over 2008 – 2010 (%).

Country	3-year average return	
	Nominal	**Real**
Turkey	16.54	7.51
Denmark	6.77	4.34
Mexico	6.76	1.82
Germany	4.68	3.27
Netherlands	4.42	2.72
Norway	3.50	0.71
Chile	2.94	-0.84
Slovenia	2.41	-0.34
Korea	2.31	-1.12
Italy	2.00	0.20
Poland	1.96	-1.50
Hungary	1.72	-3.16
Greece	1.35	-1.94
Finland	1.24	-0.48
Canada	1.23	-0.24
Czech Republic	1.15	-1.72
New Zealand	0.89	-1.85
Iceland	0.77	-8.37
Austria	0.02	-1.79
United States	-0.06	-1.72
Slovak Republic	-0.75	-3.06
Belgium	-0.78	-2.90
Portugal	-1.10	-2.20
Spain	-1.98	-3.76
Australia	-2.80	-5.63
Estonia	-3.75	-7.74
Simple average	1.98	-1.15
Weighted average	0.41	-1.42

OECD, Pension Markets in Focus, July 2011, 8, p.4

In addition, the behavior of investors in Turkish mutual funds can be regarded as another indicator of the growth potential of the Individual Pension System. As we stated before, private pension funds in Turkey are established with the structure of a mutual fund. It is observed that, in recent years, investors in mutual funds like Type A and Type B funds have been shifting to private pension funds. The mutual funds investors preferring private pension funds over Type A and Type B funds indicate that development and growth in the Individual Pension System are expected by the investors.

2.4. Type A and Type B Funds

In addition to private pension funds that are structured as mutual funds, there are two other mutual fund types in Turkish capital markets. These mutual fund types are known as Type A and Type B funds. Type A mutual funds are required to invest at least 25% of their assets in equities that are issued by Turkish companies, whereas Type B funds do not have this type of restriction in their investment decisions. These two types of mutual funds are further subcategorized according to the financial instruments comprising their portfolios. For example, in Turkish capital markets, there are mutual fund categories such as Notes and Bonds, Short-Term Notes and Bonds, Equity, Sector, Affiliate Companies, Group, Foreign Securities, Gold, Precious Metals, Variable, Balanced/Mixed or Liquid. As of 2011 year end, there exists 592 Type A and Type B funds operating in Turkish Capital Markets. Among these funds, capital protected funds, variable funds, notes and bonds funds and liquid funds are the most prevalent kinds and they constitute about 71.5% of total number of Type A and Type B funds.[11]

As of the end of 2011, there were 138 Type A funds operating in Turkish capital markets with a total fund value of TL 1.48 billion. Among Type A funds, variable funds, index funds and equity funds are the most pervasive kinds. In 2011, the share of equities in Type A funds' portfolio composition reached to 64.07%. Hence, Type A funds can be said to be appealing to investors who like to take risks. However, the number and the total fund value of Type B funds in Turkish capital markets are higher. As of the end of 2011, there were 454 Type B funds and their total fund value was TL 28.74 billion. Among Type B funds, capital protected funds, variable funds and notes and bonds funds are the most common kinds. In 2011, the reverse repo instruments had a share of 48.25% in Type B funds' portfolio composition while the share of government bonds and T-bills was 23.72%.[12]

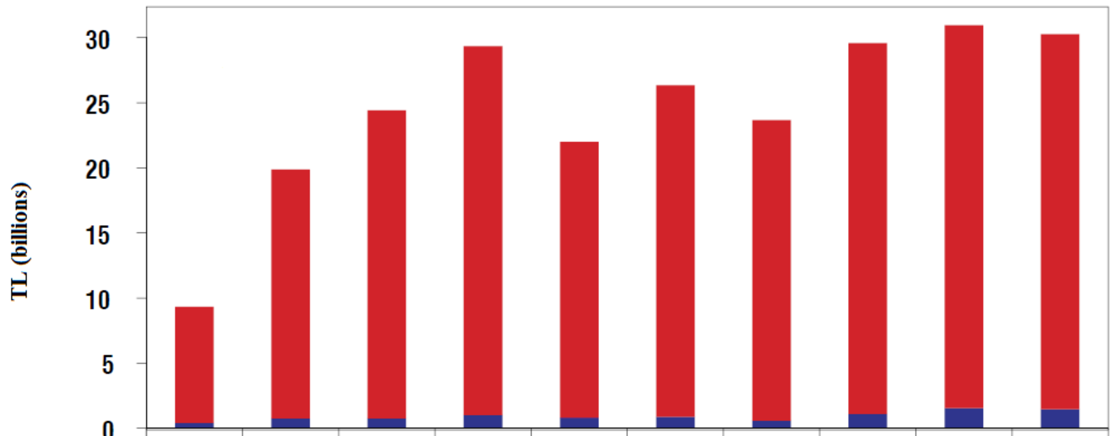
In 2011, total fund value of Type A and Type B funds decreased from TL 30.9 billion to TL 30.2 billion. More specifically, in 2011, the total fund value of Type A funds decreased by 0.075% from TL 1.6 billion to TL 1.49 billion while the portfolio value of Type B funds decreased by

[11] See Capital Markets Board of Turkey, 2011 Annual Report, p.33-37.

[12] See Capital Markets Board of Turkey, 2011 Annual Report, p.33-37.

2.04% from TL 29.4 billion to TL 28.8 billion.[13] Figure 2.4 presents the changes in portfolio values of Type A and Type B funds over the period 2002-2011.

Figure 2.4: Portfolio values of Type A and Type B funds over 2002-2011



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
B Type	8,91	19,11	23,66	28,34	21,18	25,46	23,09	28,48	29,41	28,80
A Type	0,43	0,77	0,78	1,03	0,83	0,91	0,59	1,13	1,56	1,49

years

Capital Markets Board of Turkey, 2011 Annual Report, p.34.

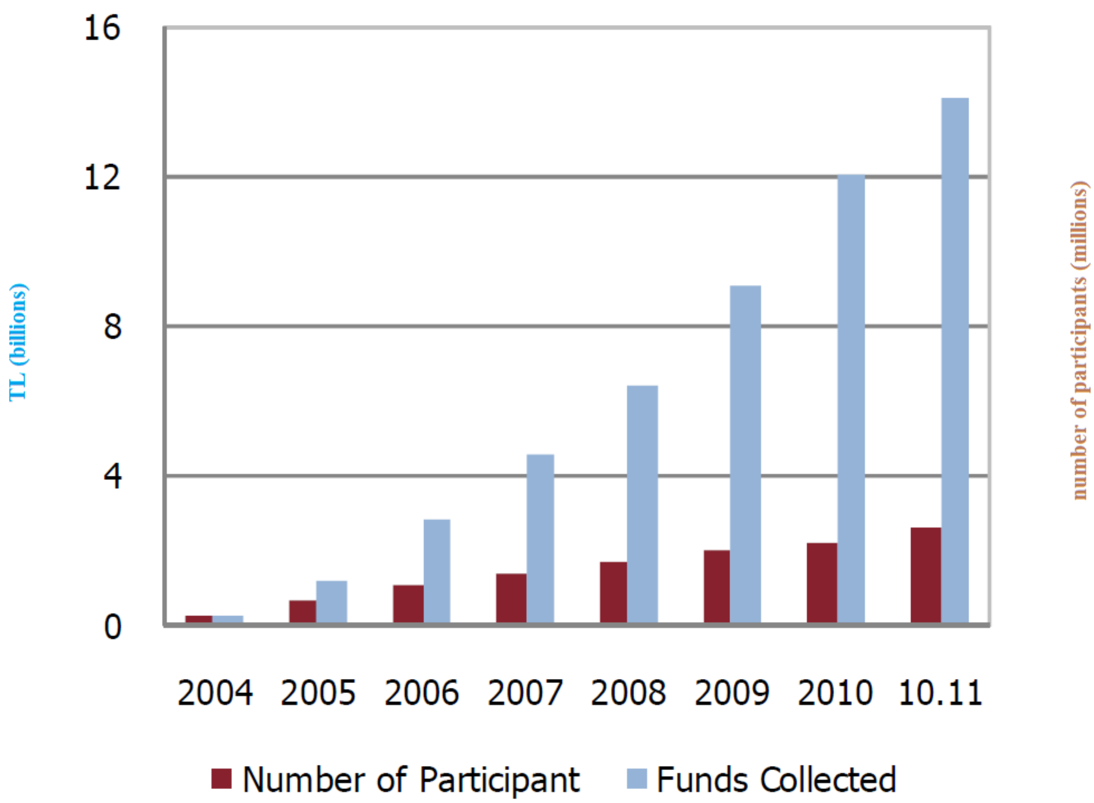
It can be seen from Figure 2.4 that both Type A funds and Type B funds showed a steady increase in portfolio value over the period 2002-2005. However, in 2006, both types of mutual funds had decreases in their portfolio holdings. In 2008, the portfolio values dropped again due to the global financial crisis. However, in the post-crisis period, Type A and Type B funds managed to keep their portfolio values stable. On the other hand, private pension funds in the Individual Pension System have been increasing their total net asset value every year since the system was first introduced in 2003. Furthermore, the Pension Monitoring Center expects that the number of participants and funds collected in the system will reach 4 million people and TL 48 billion at the end of 2015.[14] Figure 2.5 shows that both the number of participants and the total net asset value have been continuously increasing throughout the period over 2004-2011.

[13] See Capital Markets Board of Turkey, 2011 Annual Report, p.33-37.

[14] See Central Bank of the Republic of Turkey, Financial Stability Report, November 2011, 13, p.55.

Therefore, a comparison between Figure 2.4 and Figure 2.5 and the expectations about the future of the Individual Pension System can explain the motivation behind the shift of investors from Type A and Type B funds to private pension funds and the confidence built in the Individual Pension System.

Figure 2.5: Number of participants and funds collected in the Individual Pension System over 2004-2011.



Central Bank of the Republic of Turkey, Financial Stability Report, November 2011, 13, p. 55.

2.5. Portfolio Compositions of Pension Funds in the Individual Pension System

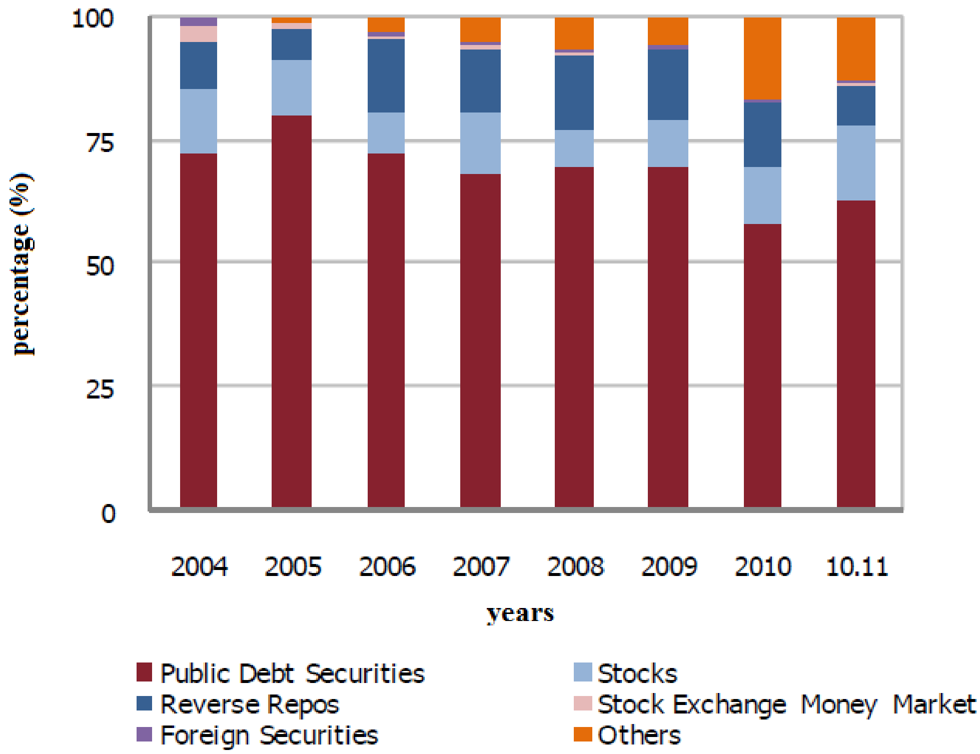
The global financial crisis affected institutional investors and banks through equity holdings in investment portfolios causing a fall in portfolio values. For this reason, mutual funds have changed their portfolio composition and investment decisions. Although countries like the United States, Australia, Finland and Chile showed significant portfolio allocations to equities in the range of 40% to 50%, private pension funds in more than half of the OECD countries allocate less than 30% of their portfolios to equities. Furthermore, in most OECD countries bonds are the main asset class accounting on average for 50% of total assets which suggests a conservative stance. In this respect, the Individual Pension System in Turkey is no exception.[15]

Market timing strategies followed by pension fund managers can also be an important determinant of changing asset allocations in portfolios of pension funds. Many flexible pension funds in the Individual Pension System in Turkey do not provide specific benchmarks in their prospectuses. These funds change their investment strategies and portfolio allocations according to the macro-economic conditions prevailing or managers' expectations of the future. We discuss market timing in more detail in Section 5.

Private pension funds in Turkey heavily invest in public debt securities like government bonds and T-bills. Figure 2.6 presents the portfolio allocations over the period 2004-2011. In every single year from 2004 to 2011, more than half of the portfolio holdings were invested in public debt securities. Stocks and money market instruments like reverse repos and short-term bonds, were the other asset classes that followed government bonds and T-bills.

[15] See Figure 3 in OECD, Pension Markets in Focus, July 2011, 8.

Figure 2.6: Portfolio composition of private pension funds in Turkey over 2004-2011



Central Bank of the Republic of Turkey, Financial Stability Report, November 2011, 13, p. 56.

Categorization of pension funds into groups such as fixed income funds, eurobond funds, money market (liquid) funds, equity funds and balanced/flexible funds is made by their asset allocations and investment strategies. As Figure 2.6 suggests, fixed income funds which mainly invest in public debt securities like government bonds and T-bills, are responsible for the majority of investments made by private pension funds, which means, as a fund group, the share of their net asset value in total is the highest among other types of pension funds. Table 2.2 shows, as of 2011 year end, there exist 31 fixed income funds and their fund group net asset value is TL 7.2 billion with a share of 50.38% in total. Flexible funds follow fixed income funds with a group net asset value of TL 3.8 billion and their share of fund group net asset value in total is 26.82%. Moreover, flexible pension funds are the most prevalent type with a number of 44, as of 2011 year end. Another major fund group is money market funds which mainly invest in short-term, liquid financial instruments. By the end of 2011, the number of money market funds is 20 and their group net asset value is TL 1.3 billion which means a share of 9.5% in total, while other fund groups (equity funds, eurobond funds, international funds and balanced funds) have group net asset values less than TL 1 billion. In 2011, international funds that invest in foreign securities and eurobond funds had annual returns of 18.56% and 18.43%, respectively. However, equity pension funds yielded an average annual return of -23.59%. Figure 2.7 shows that despite the negative return in 2011, equity pension funds managed to raise their net asset value. Also, flexible and balanced pension funds had negative annual returns in 2011 mostly due to the stock components in their portfolios. On the other hand, fixed income funds and money market funds had positive annual returns of 3.29% and 6.09%, respectively.

Table 2.2: Total net asset values and average annual returns of fund groups

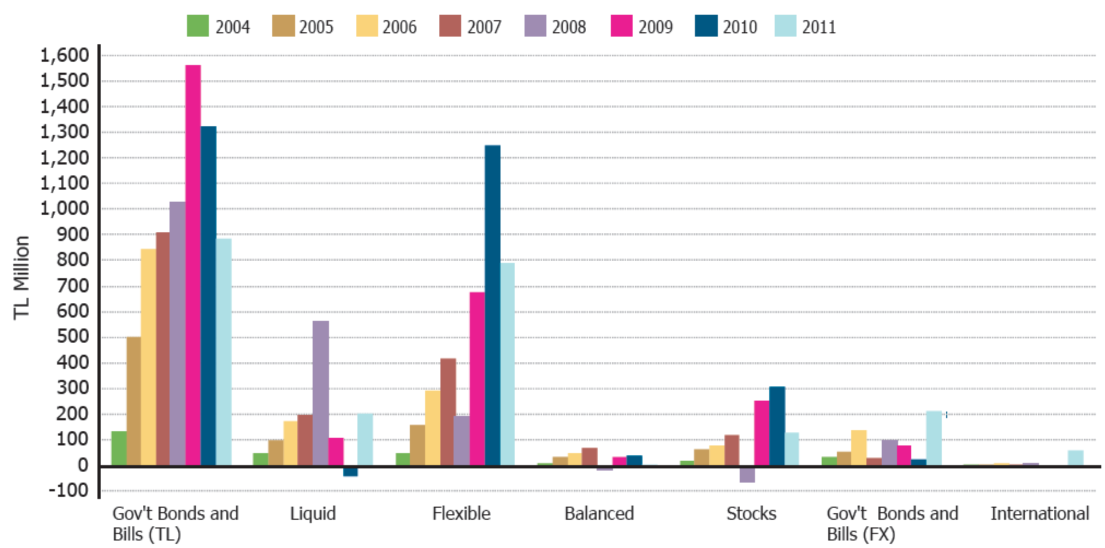
In this table, returns are weighted by daily net asset values and the funds offered to public in 2011 are excluded from the calculations.

	Number of Funds	Total Net Asset Value (TL)		Change (%)	The share of Fund Group Net asset Value in the Total (%)	Annual Return of 2011
	31.12.2011	**31.12.2010**	**31.12.2011**	**2011/2010**	**31.12.2011**	**(%)**
Gov't Bonds and Bills (TL)	31	6,320,738,159	7,205,406,611	14.00	50.38	3.29
Liquid/Money Market	20	1,159,915,328	1,358,654,924	17.13	9.50	6.09
Flexible	44	3,047,055,640	3,836,213,729	25.90	26.82	-7.05
Balanced	3	221,756,664	225,667,463	1.76	1.58	-5.31
Stocks	22	766,252,416	900,164,323	17.48	6.29	-23.59
Gov't Bonds and Bills (FX)	23	462,838,057	677,134,471	46.30	4.73	18.43
International	10	38,578,784	98,553,910	155.46	0.69	18.56
TOTAL	153	12,017,135,048	14,301,795,430	19.01	100.00	-0.99

Pension Monitoring Center, Individual Pension System 2011 Progress Report, p.62.

Throughout the period 2004-2011, fixed income and flexible pension funds managed to increase their group net asset values continuously. Figure 2.7 shows, the greatest change in group net asset value of fixed income funds occurred in 2009 with an increase around TL 1.5 billion. For the flexible funds, the greatest change was in 2010 with an increase around TL 1.2 billion. In 2008, the group net asset values of balanced funds, which have a stock component in their portfolios, and equity funds decreased due to the global financial crisis. However, considering the whole period 2004-2011, equity funds, along with fixed income and money market funds, had the greatest increases in their group net asset value in years 2009 and 2010 which can be considered as a recovery period. It can be observed from Figure 2.7 that money market funds had a boost in their group net asset value during the crisis when many investors preferred low risk, short-term and liquid investment options over stocks.

Figure 2.7: Change in net asset values of fund groups by years



Pension Monitoring Center, Individual Pension System 2011 Progress Report, p.62.

3. Survey of the Literature

There is a vast amount of literature on mutual fund performance. Since Jensen (1968), the number of studies on performance evaluation of mutual funds has been increasing significantly. The general conclusion reached in the literature is, actively managed mutual funds cannot outperform their benchmarks, the fund managers lack market timing skills and performance persistence is only a short-term phenomenon which cannot be exploited to generate abnormal returns for longer time periods. In this section, we first review the literature that finds underperformance, next we discuss the studies that find some fund managers may possess skills to outperform the market. Also, we review the literature on market timing and performance persistence phenomena. Finally, we discuss studies on Turkish mutual funds.

Jensen (1968) calculated Jensen's alphas for 115 mutual funds over the period 1945-1964 and concluded that fund managers, on average, were not able to predict security prices to outperform a passive management strategy. Also, Jensen found little evidence that any individual fund was able to perform significantly better than which could be expected from mere random chance. Malkiel (1995) studied performances of equity mutual funds over the period 1971-1991 and analyzed the returns in the context of CAPM. Malkiel found, in the aggregate, funds underperformed their benchmark portfolios both after management expenses and even gross of expenses. Malkiel concluded investors could be considerably better off by purchasing a low expense index fund, than investing in an actively managed fund. As a result, both Jensen (1968) and Malkiel (1995) argued in favor of efficient markets hypothesis.

Blake, Elton and Gruber (1993) examined the performances of bond mutual funds. They found, in general, bond funds underperformed the benchmarks post-expenses. The results indicated that the underperformance was approximately equal to the management fees. Detzler (1999) studied the risk and return characteristics of global bond mutual funds over the period 1988-1995. It was found that the actively managed funds, net of expenses, did not demonstrate superior performance against their benchmarks and the performance was negatively related to the expenses. Davis (2001) analyzed the relationship between equity mutual fund performance and manager style. During the 1965-1998 sample period, none of the styles earned positive abnormal returns and value funds generated negative abnormal returns of about -275 basis points. Christensen (2005) investigated the performances of 34 equity and 13 fixed income funds over the period 1996-2003 and concluded that Danish mutual funds did not generate positive abnormal returns.

Fama and French (2008) examined the mutual fund performance from the perspective of equilibrium accounting over 1984-2006 period. They concluded mutual funds, on average, underperformed their benchmarks in three-factor and four-factor models by the amount of fees and expenses. Moreover, Fama and French discussed, regardless of being good or bad, that the individual mutual fund performance was due to chance rather than skill.

Casarin, Pelizzon and Piva (2008) showed, in general, fund managers were not able to score extra performances and only few managers had security selection ability during their analysis period over 1988-1999. Dietze, Entrop and Wilkens (2009) examined the risk adjusted performance of mutual funds offered in Germany which exclusively invest in euro-dominated investment grade corporate bonds. They found evidence that corporate bond funds, on average, underperformed the benchmarks. In addition, none of the funds analyzed showed a significant positive performance. Another study from the recent literature is Bacon and Prince (2010) which analyzes the small cap growth stock sector of the mutual fund industry over the period 1997-2006. Although some funds generated excessive returns, Bacon and Prince, in the aggregate, did not find evidence against market efficiency.

Even though most studies are in line with the efficient market hypothesis, there is a significant number of studies in the literature which report some skilled mutual fund managers may generate positive abnormal returns. Grinblatt and Titman (1989) found the risk-adjusted gross returns of some funds in their sample were significantly positive in the 1975-1984 time period and concluded that this abnormal performance was partly due to the active management of the funds. Ippolito (1989) found that US mutual funds outperformed passive index funds over the period 1965-1984.

Coggin, Fabozzi and Rahman (1993) examined the selectivity and market timing performance of a sample of US pension funds. Regardless of the choice of benchmark portfolio and the estimation model, on average, evidence of security selection ability was found.

Wermers (2000) measured the performance of the mutual fund industry from 1975 to 1994 by decomposing fund returns and costs into various components. Wermers concluded mutual fund managers pick stocks that beat the market portfolio by almost enough to cover their transaction costs and expenses which is in line with the equilibrium model suggested by Grossman and Stiglitz (1980).

Otten and Bams (2002) investigated the mutual fund performances in five European countries using a sample of 506 funds. They employed Carhart's (1997) 4-factor asset-pricing model to correct mutual fund performance by using factor-mimicking portfolios for size, book-to-market and stock-price momentum. They found that most European mutual funds had positive alphas after costs had been deducted.

Azar and Hourani (2010) measured the performances of 200 US equity mutual funds by Jensen's alpha using four stock market indexes as benchmarks. Azar and Hourani found evidence that the S&P 500 is the most appropriate benchmark and argued that the performance of US equity mutual funds after expenses is either statistically significant or at least marginally significant.

Another recent study on mutual fund performance is Andonov, Bauer and Cremers (2011) which assesses security asset allocation, market timing and security selection components of active management. Andonov et al. found security selection explains for most of the return differences. Both before and after risk-adjusting and using the three components of active management, they showed, on average, large pension funds generated abnormal positive returns with an annual alpha of 16 basis points from asset allocation changes, 27 basis points from market timing and 45 basis points from security selection.

In the literature, there are a number of studies on market timing abilities of mutual funds. Treynor and Mazuy (1966) developed an extension of CAPM to test for market timing ability of the fund managers. They found that only 1 out of 57 open-end mutual funds appeared to show a curvature in its characteristic line which indicates mutual fund managers, in general, did not have the ability to time the market. On the other hand, Kon (1983) found that, at the individual fund level, there is evidence of significant superior timing ability and performance. However, Kon's results were not inconsistent with the efficient markets hypothesis. It was found that fund managers as a group had no special information regarding the formation of expectations on the returns of the market portfolio.

Henriksson (1984) analyzed the market timing performance of 116 open-end mutual funds over the period 1968-1980 using the parametric and non-parametric techniques presented by Henriksson and Merton (1981). The findings suggest that, in general, mutual fund managers were not able to follow an investment strategy that successfully times the return on market portfolio. Chang and Lewellen (1984) also used the parametric procedure developed by Henriksson and Merton to test jointly for the presence of either superior market timing or security selection ability in a sample of mutual funds. The findings suggest that few fund managers appeared to display market timing skills. Goetzmann, Ingersoll and Ivkociv (2000) employed four different tests for market timing and the results indicate, regardless of the test, very few funds from their sample of 558 mutual funds exhibited significant positive timing skills.

Swinkels, Sluis and Verbeek (2003) investigated the investment performance of mutual funds using a sample of 78 funds with an asset allocation objective. The findings indicate that the funds in the sample varied their market exposures substantially over time. However, there was not any evidence that the cross sectional expected return differences due to time variation were significant. On average, the returns to market strategies were absent, even though some fund managers appeared to possess market timing skills.

Comer (2006) included a bond index and a bond timing variable in a multi-factor extension of the Treynor and Mazuy model. Over the period from 1992 to 2000, the multi-factor model provided evidence of significant timing skill. Also, Jiang, Yao and Yu (2007) found, on average, actively managed US domestic equity funds have positive timing ability.

Cuthbertson, Nitzsche and O'Sullivan (2010) studied the market timing skills of UK equity and balanced mutual fund managers. The findings indicate only 1% of funds demonstrated market timing skills at 5% significance and 19% of funds showed negative market timing skills. Another recent study on market timing is Frijns, Gilbert and Zwinkels (2011) where an approach that builds on an heterogenous agent model was proposed. In this approach, investors switch between cash and stocks depending on a certain switching rule. Frijns et al. applied this model to a sample of 400 US equity mutual funds and found that 41.5% of the funds had negative market timing skills, while only 3.25% seemed to exhibit positive skills.

In the literature on mutual fund performance, persistence in returns is a widely studied phenomenon. In general, it is found that there is evidence of short-term persistence but this persistence tends to fade away for longer periods of time. Hendricks, Patel and Zeckhauser (1993) examined the quarterly returns of open-end, no-load, growth-oriented equity funds over the sample period 1974-1988. They found that portfolios constructed from recent poor performers significantly underperformed the standard benchmarks and portfolios of recent top performers overperformed, though not significantly. The findings indicate short-term persistence was significant and peaked at roughly four quarters.

Grinblatt and Titman (1992) used a sample consisting of monthly cash-distribution-adjusted returns and investment goals of 279 mutual funds over the period 1974-1984 to examine how mutual fund performance relates to past performance. They found evidence that differences in performance between funds persisted over time. The results indicate that the positive persistence is consistent with the ability of managers to earn abnormal profits.

Blake, Elton and Gruber (1993) examined whether past alphas are predictive of future alphas in bond mutual funds. They divided their sample period into several sub-periods and calculated alphas for each sub-period by six different models. None of the models produced useful information about the future performances of the funds in general. On the other hand, Malkiel (1995) found evidence of persistence during 1970s by simulating a variety of investment strategies. However, during 1980s, the evidence of persistence disappeared. Also, Malkiel reported that the findings were likely to be influenced by survivorship bias.

Carhart (1997) found that the persistence in equity mutual funds' mean and risk-adjusted returns were almost completely explained by common factors in stock returns and investment expenses. His results did not support the existence of skilled or informed managers. Moreover, Carhart concluded that transaction costs consume gains from following a momentum strategy in stocks.

Casarin, Pelizzon and Piva (2008) carried out a comprehensive analysis on persistence of Italian mutual funds' performances. In addition to studying the relation between returns, they examined the effects of other variables such as performance measure, evaluation lag and statistical tests on persistence. Overall, they did not find evidence of short-term or long-run persistence.

In recent years, there have been some studies on Turkish mutual fund performance. Gürsoy and Erzurumlu (2001) measured the performances of 55 Type A and 77 Type B mutual funds operating in Turkish capital markets, relative to T-bill rates and ISE National 100 index from January, 1998 to June, 2000 using Sharpe, Treynor, Jensen and Graham & Harvey indices. They found different performance measurements ranked the portfolios similarly. The results indicate T-bills were the best investment option over the analysis period, followed by ISE National 100 index, Type B funds and Type A funds respectively. Overall, Gürsoy and Erzurumlu did not find evidence that active mutual funds can outperform the market. Korkmaz and Uygurtürk (2007) applied single- and multi-factor regression models to analyze performances of 46 Turkish pension funds using weekly returns over the period January, 2004 and June, 2006. They used ISE National 100, KYD General Bond Index (TL) and KYD O/N Net Repo Index (TL) as their benchmarks. Their results indicate pension funds, in general, seem to be successful in single-factor and two-variable analyses, However, it was found that their success rates fall considerably in the three-factor model. As a result, Korkmaz and Uygurtürk concluded that Turkish pension funds show decreasing performance as the number of benchmarks included in the analysis increases. Karatepe and Gökgöz (2007) investigated the performances of 15 Type A (equity) mutual funds in Turkey over 2000-2001 period. They employed Treynor and Mazuy's (1966) quadratic regression model to the weekly returns to estimate the security selection ability (alpha), the systematic risk (beta) and market timing skills. Karatepe and Gökgöz found 5 funds overperformed the ISE National 100 index, while only 1 fund underperformed. The results also show that only 2 funds seemed to have market timing ability. In addition, it was documented that Turkish equity funds did not exhibit performance persistence due to the financial crises Turkey experienced over the sample period 2000-2001. Korkmaz and Uygurtürk (2008) compared the performances of Turkish pension funds to those of Type A and Type B funds over the sample period January 2004 to December 2006. In particular, equity pension funds were compared to Type A mutual funds while fixed income pension funds were evaluated against Type B mutual funds. It was found that pension mutual funds, in general, performed better than Type A and Type B funds over the analysis period. Moreover, the results indicate that none of the Type A or Type B mutual funds appeared to have market timing ability, while one of the pension funds exhibited significant market timing skill.

4. Data and Assumptions

In this thesis, we use a unique sample that is obtained from Forex database. The sample includes daily net asset values and portfolio allocations of Turkish pension funds in the Individual Pension System. Due to the small number of pension funds when the system was first introduced in the second half of 2003, we decided to analyze the performances of pension funds from July, 2004 to August, 2011. We required the funds in our sample to have at least 36 months of data to be included in the analysis. In total, we have analyzed 65 pension funds which are grouped into 6 categories. Our sample includes 12 money market funds, 14 fixed income funds, 14 flexible funds, 2 balanced funds, 11 equity funds and 12 eurobond funds. The categorization of the funds is made according to their portfolio structures and investment strategies.

Money market funds generally invest in short-term, low risk and liquid financial instruments, while fixed income funds are mainly invested in public debt securities. Flexible funds, on the other hand, do not have a particular investment strategy. These funds can alter their portfolio allocations as the market conditions change. For this reason, many funds in this group do not have a benchmark in their prospectuses. Balanced funds, as the name "balanced" suggests, include a stock component and a bond component in their portfolio. Equity funds invest heavily in stocks and the main investment tool for the eurobond funds is foreign debt securities that are issued by the Turkish government.

Every fund in our sample is labeled with a unique 3-letter code. In the tables, these unique codes, instead of funds' full names, are used to identify the funds (see Table A.1).

4.1. Survivorship Bias

In the presence of survivorship bias, the mutual fund performance tends to be overstated. It is possible that superior performing funds in one period may have taken very risky bets and won. If the bets fail in the next period, the fund management companies may terminate the funds or merge them with other successful funds to bury the records of poor performance. In addition, some mutual fund management companies can start a number of small funds and wait a few years to see which ones outperform the market, ending the operations of the unsuccessful ones. This type of management strategy can also induce survival bias (see Malkiel, 1995).

Malkiel (1995) measured the extent of survivorship bias in equity mutual funds over the period 1982-1991. It was found that the average yearly return in the sample including non-surviving funds was 15.69%, net of expenses. However, when Malkiel included, in his sample, only the funds surviving throughout the period from 1982 to 1991, the average yearly net return increased to 17.09%. Malkiel also analyzed a longer time period extending to 1970s and the results obtained were even more dramatic. The average annual net return for the surviving funds which existed throughout the analysis period was 18.7%, while it was only 14.5% for all funds including non-survivors.

The issue of survivorship bias plagues some earlier studies on Turkish mutual fund performance. Karatepe and Gökgöz (2007) analyze the performances of 15 Turkish equity (Type A) funds which were continuously in operation during 2001-2002 and conclude most of the funds performed over the benchmarks. Korkmaz and Uygurtürk (2007) investigate the performances of 46 Turkish pension funds which survived throughout January, 2004 – June, 2006 period and conclude the pension funds showed a decreasing performance as the number of benchmarks included in the analysis increased. Korkmaz and Uygurtürk (2008) compare the performances of 17 Turkish pension funds and 17 Turkish mutual funds (Type A and Type B funds) which operated without a break, termination or liquidation for the full period from January, 2004 to December, 2006 and conclude that, in general, pension funds performed better than mutual funds.

We cannot say anything regarding the robustness of the results in these studies without estimating the importance of survivorship and sample selection biases. However, when interpreting the results, it should always be kept in mind that, in the presence of these types of biases, an incorrect reflection of the pension/mutual fund market may prevent flawless inference. Unfortunately, we cannot claim that, in our study, we completely eliminate the effect of survivorship bias, mostly due to the fact that we require at least 36 months of returns data to evaluate the performance of a fund. However, our sample suffers relatively less from the survival effect as 5 funds in this analysis are non-survivors.

4.2. Assumptions for the Regressions

In this study, security selection and market timing ability of the pension fund managers and the short-term persistence phenomenon were measured by time-series regressions under Gauss-

Markov assumptions for OLS estimation. Hayashi (2000) provides an excellent discussion of these assumptions.

4.2.1. Linearity

Linearity assumption requires that the relationship between the dependent variable and independent (explanatory) variables is linear. A linear regression model can be structured as:

$$y_i = \beta_1 x_{i1} + \beta_2 x_{i2} + \cdots + \beta_K x_{iK} + \varepsilon_i \quad (i = 1,2,\ldots,n) \tag{4.1}$$

where β's are regression coefficients to be estimated and ε_i is the unobserved error term. In the model, β's can be considered as the sensitivity of the dependent variable, y_i, with respect to changes in regressors, x_i's. The linearity assumption ensures the dependent variable can be written as a linear function of the regressors implying that the coefficients and regressors are not dependent on each other.

Our analysis is mostly based on CAPM and its extensions, and CAPM implies the relationship between the returns and the risk is linear. Hence, we assume the linearity assumption holds in our study.

4.2.2. Strict Exogeneity

This assumption states that the conditional expectation of the error term is zero. It can be formalized as follows:

$$E(\varepsilon_i|\boldsymbol{X}) = 0 \qquad (i = 1,2,\ldots,n) \tag{4.2}$$

where $\boldsymbol{X}$ represents the set of regressors from all observations which is known as the data matrix.

The strict exogeneity assumption has two important implications. First, under this assumption, the unconditional expectation of the error term is also zero[16], i.e.,

$$E(\varepsilon_i) = 0 \qquad (i = 1,2,\ldots,n). \tag{4.3}$$

[16] The Law of Total expectations states that $E(\varepsilon_i) = E[E(\varepsilon_i|\boldsymbol{X})]$.

The second implication is that any regressor from the data matrix, $\boldsymbol{X}$, is orthogonal to the error terms from all observations. This can be formally stated as:

$$E(x_{jk}\varepsilon_i) = 0 \quad (i, j = 1, \dots, n; k = 1, \dots, K) \tag{4.4}$$

where K is the number of regressors in each observation. These two implications can further be used to conclude that any regressor from the data matrix is uncorrelated with the error term from any observation. This can be shown as:

$$\begin{aligned} Cov(\varepsilon_i, x_{jk}) &= E(x_{jk}\varepsilon_i) - E(x_{jk})E(\varepsilon_i) \\ &= E(x_{jk}\varepsilon_i) \qquad \text{(since } E(\varepsilon_i) = 0 \text{ by (4.3))} \\ &= 0 \qquad \text{(by (4.4))} \end{aligned} \tag{4.5}$$

In this study, we do not directly test if this assumption is satisfied. However, we test for the normality assumption which requires the error terms conditional on the data matrix are jointly normally distributed around zero.

4.2.3. No Perfect Multicollinearity

This assumption requires there is not a perfect linear relationship between explanatory variables. In our regression models to estimate security selection skills, market timing ability or short-term persistence, various benchmarks are used as regressors. It is expected that the benchmarks can be correlated with each other to some extent. However, a perfect linear relationship between them is not allowed so that rank of the $n \times K$ data matrix, $\boldsymbol{X}$, is K which is crucial to obtain unique estimates for the coefficients[17].

We do not need to test for this assumption in our analyses because the software we use, Stata, does not estimate models with perfect multicollinearity. Hence, Stata automatically checks for this assumption.

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[17] For the derivation of the OLS estimate, see Hayashi, F., 2000, Econometrics, Princeton University Press, p.15-18.

4.2.4. Homoskedasticity and No Autocorrelation

The homoskedasticity assumption requires that the second conditional moment of the error term is equal to a constant, σ^2. Formally, this assumption states:

$$E(\varepsilon_i^2|\boldsymbol{X}) = \sigma^2 > 0 \quad (i = 1,2, \dots, n) \tag{4.6}$$

which implies the conditional variance of the error term is also constant and equals σ^2. This is because

$$\begin{aligned} Var(\varepsilon_i|\boldsymbol{X}) &= E(\varepsilon_i^2|\boldsymbol{X}) - E(\varepsilon_i|\boldsymbol{X})^2 \\ &= E(\varepsilon_i^2|\boldsymbol{X}) \qquad \text{(by (4.2))}. \end{aligned}$$

The no autocorrelation assumption requires the error terms are not autocorrelated between observations. This assumption is given as:

$$E(\varepsilon_i\varepsilon_j|\boldsymbol{X}) = 0 \quad (i, j = 1,2, \dots, n; i \neq j) \tag{4.7}$$

which further implies

$$Cov(\varepsilon_i, \varepsilon_j|\boldsymbol{X}) = 0 \quad (i, j = 1,2, \dots, n; i \neq j) \qquad \text{(by (4.2) and (4.5))}.$$

Both homoskedasticity and no serial autocorrelation assumptions are used to derive test statistics for hypothesis testing. Therefore, if these assumptions are not satisfied, our inference based on t-statistics to test for the significance of individual coefficients (security selection or market sensitivity) will not be valid.

We use Breusch-Pagan test in order to see if homoskedasticity assumption is fulfilled. In this test, the squared residuals from the fitted model are simply regressed on the regressors from the original model. In order to check if no-serial-autocorrelation assumption holds, we employ Bresch-Godfrey test which takes residuals from the regression model, like Breusch-Pagan test, and regresses them on the original explanatory variables as well as lagged residuals. Both tests produce a χ^2-test statistic. If the associated p-value is below the significance level, we reject the null hypothesis of homoskedasticity or no-serial-autocorrelation in the errors. In that case, we use heteroskedasticity and autocorrelation consistent (HAC) standard errors to calculate the t-statistics.

4.2.5. Normality in the Errors

This assumption requires the distribution of $\boldsymbol{\varepsilon}$, the vector of error terms from all observations, conditional on $\boldsymbol{X}$, the data matrix, is jointly normal. This can be formalized as:

$$\boldsymbol{\varepsilon}|\boldsymbol{X}\sim N(\mathbf{0},\sigma^2\boldsymbol{I_n}) \tag{4.8}$$

where $\boldsymbol{I_n}$ is an $n \times n$ identity matrix and σ^2 is a constant.

The normality assumption is the strongest among all Gauss-Markov assumptions. However, it is very crucial for hypothesis testing. Without this assumption, we would not know the theoretical distribution of our test statistic. Hence, it needs to be checked whether this assumption is fulfilled in our models. For this reason, we employ a skewness/kurtosis test to see if the error terms are jointly normally distributed. If the normality assumption is not satisfied, then our results should be interpreted carefully.

4.3. Benchmarks

The results from the performance tests are highly dependent on the benchmarks employed. Ippolito (1989) and Elton, Gruber, Das and Hlavka (1993) illustrate the importance of benchmark selection in the interpretation of mutual fund performance. Ippolito concluded that the risk-adjusted returns of mutual funds, net of expenses and fees, were comparable to returns from index funds. But, Ippolito did not have a benchmark for non-S&P stocks in is sample. Elton et al. found that returns on non-S&P stocks, as well as returns on S&P stocks and bonds, were significant in performance assessment. When they included a benchmark for non-S&P stocks, it was found that mutual funds did not earn abnormal returns to cover the information acquisition costs. Hence, Ippolito's conclusion about mutual fund performance was reversed.

In order to determine the proper benchmarks for fund groups, portfolio structures and information in funds' prospectuses are investigated. As a result, we decide to include six benchmarks in the analysis. More specifically, we use ISE National 100 index for stocks; KYD General Bond Index (TL) and KYD 91 Days Bond Index (TL) for bonds; KYD O/N Gross Repo

Index for reverse repo instruments and KYD Eurobond Index (USD-TL) and KYD Eurobond Index (EUR-TL) for eurobonds. KYD indices are calculated by Turkish Institutional Investment Managers' Association (TKYD) and ISE National 100 index is prepared by Istanbul Stock Exchange. All benchmarks are measured in Turkish lira. However, it must be noted that KYD Eurobond Index (USD-TL) and KYD Eurobond Index (EUR-TL) are calculated for foreign currency denominated securities. Hence, for these two indices, conversions from Euro or US dollar to Turkish lira are made.

In our single-factor models, only one benchmark is used to estimate alphas. For equity pension funds, ISE National 100 index is selected as the benchmark, while performances of the fixed income pension funds are evaluated against KYD General Bond Index (TL). However, portfolio compositions of the money market funds, balanced funds, flexible funds and eurobond funds do not allow to measure the performance with a single benchmark. As a result, establishing composite benchmarks by using several indices with certain weights is considered to be appropriate in our single-factor models. Decision upon selection of sets of indices and the weights is made through the portfolio allocations and investment strategies with referencing to fund prospectuses, if available.

As can be seen in Table 4.1, money market composite benchmark (MM_composite) is established by taking 60% of returns from KYD O/N Gross Repo Index (TL) and 40% of returns realized by following KYD General Bond Index (TL). Flexible composite benchmark (FL_composite) weighs KYD General Bond Index (TL) and ISE National 100, by 80% and 20% respectively. For balanced composite benchmark (BA_composite), on the other hand, the weights assigned to KYD General Bond Index (TL) and ISE National 100 are 60% and 40%, respectively. Lastly, for the eurobond composite benchmark (EU_composite), the indices KYD Eurobond Index (USD-TL) and KYD Eurobond Index (EUR-TL) are weighted equally.

Table 4.1: Weights used to construct composite benchmarks

composite benchmarks	weights					
	ISE National 100	KYD General Bond Index (TL)	KYD Bond Index 91 Days (TL)	KYD O/N Gross Repo Index (TL)	KYD Eurobond Index (USD-TL)	KYD Eurobond Index (EUR-TL)
MM_composite		40%		60%		
FL_composite	20%	80%				
BA_composite	40%	60%				
EU_composite					50%	50%

In our multi-factor models, we use 3 or 4 benchmarks depending on the fund group. The sets of benchmarks to be employed for each fund group are determined after a thorough investigation of portfolio structures and prospectuses of pension funds. In general, we decide to include a benchmark for a group if its coefficient is estimated to be significantly different than zero for at least one fund in the group (at 20% significance level). Table 4.2 shows which set of benchmarks is used for any group of funds. For money market pension funds, KYD O/N Gross Repo Index (TL), KYD Bond Index 91 Days (TL) and KYD General Bond Index (TL) are used in the multi-factor models. We add ISE National 100 to these benchmarks to estimate alphas for the fixed income and flexible pension fund groups. However, in the analysis for the balanced and equity pension funds, we drop KYD Bond Index 91 Days (TL) and employ the remaining three benchmarks in the set. Lastly, for the Eurobond pension funds, we include KYD General Bond Index (TL), KYD Eurobond Index (USD-TL) and KYD Eurobond Index (EUR-TL).

Table 4.2: Sets of benchmarks used in the multi-factor model for different fund groups

pension fund groups	KYD O/N Gross Repo Index (TL)	KYD Bond Index 91 Days (TL)	KYD General Bond Index (TL)	KYD Eurobond Index (USD-TL)	KYD Eurobond Index (EUR-TL)	ISE National 100
money market	+	+	+			
fixed income	+	+	+			+
flexible	+	+	+			+
balanced	+		+			+
equity	+		+			+
eurobond			+	+	+	

Karacatepe and Gökgöz (2007) use Government Debt Securities Performance Index (30 days), calculated by Istanbul Stock Exchange, as a proxy for the risk free rate of return. Korkmaz and Uygurtürk (2008), on the other hand, use KYD O/N Net Repo Index. However, in this study, we assume the risk free rate follows KYD Bond Index 30 Days (TL).

4.4. Unit Root Test

Following Christensen (2005) and Korkmaz and Uygurtürk (2008), we test the stationarity of time series that we use in the analysis. A time series is said to be stationary if the statistical properties of the series do not change over time. More specifically, mean and variance of the series is constant with respect to time. Moreover, covariance between two points in a stationary time series depends on the distance between these points, not on time. In other words, when we shift in time, the covariance between the points will stay the same. If the time series are stationary, then a shock will only have a temporary effect. In the long run, the series will retain its statistical properties (Korkmaz and Uygurtürk, 2008).

We employ the Augmented Dickey-Fuller (ADF) test with 12 lags to see if the excess returns of the funds and benchmarks are stationary. The test statistic is calculated from the following regression:

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \sum_{j=1}^{12} \beta_j \Delta Y_{t-j} + \varepsilon_t \qquad (4.9)$$

In the model, Y is the time series to be tested and ε_t is the error term. In this test, the null hypothesis H_0: $\alpha_1 = 0$ is tested against the alternative H_1: $\alpha_1 < 0$. If we reject the null, then the series is said to be stationary. If we fail to reject the null, then the series is non-stationary and has a unit root (Korkmaz and Uygurtürk, 2008).

In total, we confirm stationarity for 1 fund at 10% and for the remaining 64 funds and 6 benchmarks at 1% significance level (see Table A.2).

5. Theory and Methodology

In this section, we present various analyses to measure the security selection skills and market timing abilities of the pension fund managers and performance persistence. The methodology is mostly based on the efficient markets hypothesis and CAPM. Hence, before describing our models employed to evaluate the performance, we provide a discussion about the efficient markets hypothesis and CAPM.

5.1. Informationally Efficient Markets

A market is said to be efficient if the current security prices fully incorporate all the available information so that generating excess returns using this information is impossible. The proponents of the efficient markets hypothesis believe, when new information arises in the market, it spreads quickly and gets incorporated in the prices without a delay. Under this hypothesis, the stock prices are said to display a random-walk behavior, that is, the prices go up and down without exhibiting any predictable patterns. The randomness in the flow of information and the fact that the new information is immediately incorporated in the stock prices are reasons behind this behavior. Hence, an investor cannot be better off by searching for underpriced securities to earn higher excess returns, than simply investing in a portfolio of randomly selected stocks. If prices reflect all available information, even uninformed investors will earn the returns as high as those achieved by the experts (Malkiel, 2003).

Fama (1970) argues the hypothesis that security prices, at any point in time, fully reflect *all* available information is rather extreme and hence it is not expected to be literally true. For this reason, Fama tests efficiency with three subsets of information. In particular weak form, semi-strong form and strong form tests are employed. Fama points out that this type of categorization in the tests helps to find out the level of information at which the hypothesis breaks down. Weak form efficiency implies the information set of historical prices is fully reflected in the current prices. The random walk behavior of the security prices, that is subsequent price changes are results of purely random and unpredictable departures from the previous prices, is in line with this type of efficiency. In other words, analyses based on historical prices alone do not provide any useful information to determine underpriced securities. Under semi-strong form efficiency, prices reflect all publicly available information (e.g., annual reports, financial statements, etc.), in addition to the information set of historical prices. Hence, any form of technical or fundamental analyses using publicly available information will not allow an investor to pick undervalued securities to earn abnormal profits. Under strong form efficiency, the prices reflect *all* available information, public or private. Fama argues that under this form of efficiency, any investor who has monopolistic access to some information cannot realize higher profits than other investors. In other words, if a market is efficient in its strongest form, even insider trading is not useful for an investor seeking higher returns than the market. However, Fama discusses that a market where prices fully reflect *all* available information would not be an exact description of reality. Hence, a test for strong-form efficient markets should only aim to estimate the deviations from the market efficiency.

Fama's results support the weak form and semi-strong form of market efficiency. However, he finds some evidence against strong form efficiency. Another important study which challenges the efficient markets hypothesis is by Grossman and Stiglitz (1980) who argue that prices cannot reflect all available information. Grossman and Stiglitz discuss that if prices incorporate all available information, the investors who spend resources to obtain it will receive no compensation. Since investors are assumed to be rational, they should at least cover their information-seeking costs by earning abnormal returns as a result of their efforts to find undervalued securities.

5.2. The Capital Asset Pricing Model (CAPM)

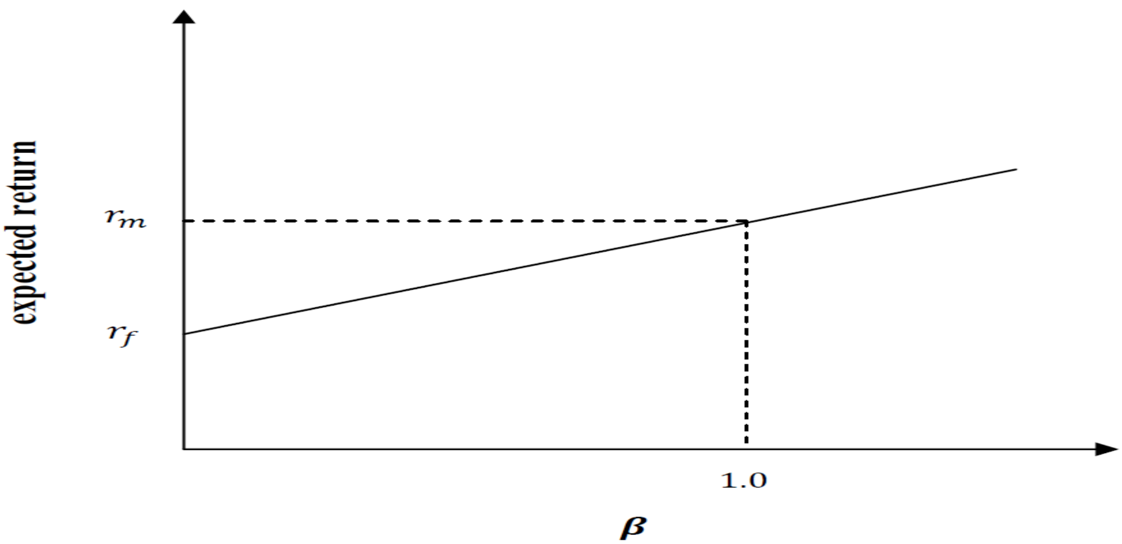
The CAPM was developed independently by Sharpe (1964), Lintner (1965), and Mossin (1966). It depicts the relationship between expected return of a capital asset and the risk undertaken. Formally, the CAPM is given as:

$$r_i = r_f + \beta \, (r_m - r_f) \qquad (5.1)$$

where r_i and r_m are the expected returns of the capital asset i and the market portfolio, respectively. β is the sensitivity (systematic risk) of the expected return of the asset i to the expected excess return on the market, and r_f is the risk free rate of return.

In figure 5.1, the security market line (SML), which is a graphical representation of the CAPM, is displayed. The slope of the SML is the market risk premium, $(r_m - r_f)$. When the systematic risk, β, increases, the expected return of the capital asset increases as well. Also, when the systematic risk is 1, the expected return of the capital asset is equal to the expected market return, r_m. The points on the SML represent the required rate of return for the given level of risk. Hence, correctly priced securities are plotted on the SML. If the return of a security is above the SML, then the security is said to be underpriced because it realizes a higher return than CAPM predicts, for a given level of risk. By the same logic, if a security is plotted below the SML, it is said to be overvalued since it realizes a lower return than required, given its level of risk.

Figure 5.1: The Security Market Line (SML)



Although the CAPM is being widely used in many financial analyses, it receives a lot of criticism. Most of the criticism is based on the validity of its theoretical and unrealistic assumptions. The CAPM assumptions are as follows[18]:

1. Investors make their investment decisions based on the expected returns and variance of the past returns and hold diversified portfolios eliminating the non-systematic risk,
2. Investors are rational and risk averse so that they want to maximize their returns given the level of risk they are taking,
3. Investors have the same time horizon for their investments,

[18] See Fabozzi, Frank J., Neave, Edwin H. and Zhou, G., 2011, Financial Economics, John Wiley & Sons, p.288.

4. Investors have the same expectations about the future returns and risk of the securities,
5. The investors can borrow and lend unlimited amounts at the risk free rate,
6. Capital markets are completely competitive so that no buyer or seller can exercise control over the prices, and
7. Capital markets are frictionless so that there are no costs or restrictions on transactions.

Mullins (1982) reports that, although CAPM's assumptions are unrealistic, such simplification of reality is necessary to develop useful models. He argues that tolerance of the CAPM's assumptions allows the derivation of a solid, though idealized, model for the practice of how financial markets measure the risk and calculate expected returns.

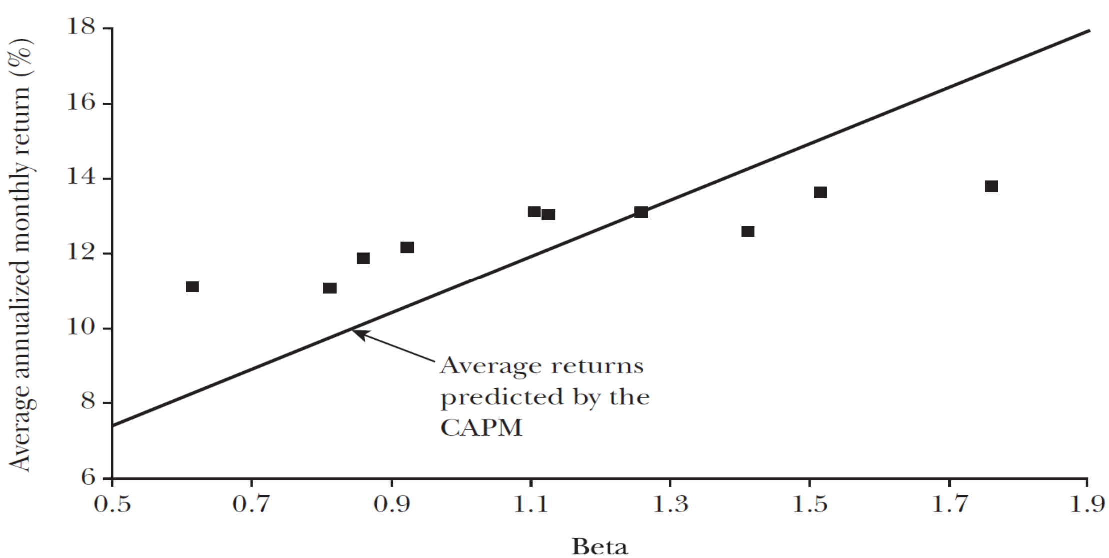
Roll (1977) argues that the only testable hypothesis associated with CAPM is on the mean-variance efficiency of the market portfolio. The model's implication of the linearity between the expected return and beta follows from the market portfolio's efficiency and is not independently testable. Although betas calculated with ex-post mean-variance efficient portfolios will be exactly linearly related to the mean returns in a sample of observations on individual returns (regardless of the true market portfolio being mean-variance efficient or not), the theory is not testable unless the exact composition of the true market portfolio is known. Roll further argues that there are two problems in using proxies for the market portfolio. Firstly, the proxy may be mean-variance efficient when the true market portfolio is not. In this case, every sample of individual assets will display efficient portfolios and satisfy all the implications of the CAPM which suggests an inaccurate description of the market. On the other hand, market proxy may turn out to be inefficient which is in contrast with the 'if and only if' relation between beta/return linearity and true market portfolio's mean-variance efficiency. The second problem is that, although most reasonable market proxies are often highly correlated with each other and with the true market portfolio whether or not they are mean-variance efficient, they can cause quite different inferences, implying that benchmark selection is a crucial part of the performance evaluation processes.

There are a number of studies which empirically test the CAPM.[19] These studies conclude the relation between the average return and the risk is flatter than what the model predicts. In other words, the empirical SML has a lower slope than the theoretical line. Fama and French (2004)

[19] These studies include Douglas (1968), Black, Jensen and Scholes (1972), Miller and Scholes (1972), Blume and Friend (1973) and Fama and Macbeth (1973).

confirm this evidence from earlier studies. In their cross sectional regression, the intercept is the risk free rate and the coefficient on beta is the expected market return in excess of the risk free rate. In December of each year, Fama and French estimate a pre-ranking beta for every NYSE (1928 – 2003), AMEX (1963-2003) and NASDAQ (1972-2003) stock in the CRSP database using 2 to 5 years of monthly returns. Fama and French then form ten value weighted portfolios based on the pre-ranking betas and compute their returns for the next 12 months. In total, from 1928 to 2003, Fama and French calculate 912 monthly returns on ten beta-sorted portfolios. Figure 5.2 plots each portfolio's average return against its post-ranking beta, estimated by regressing its monthly excess returns for 1928-2003 on the excess return of the market portfolio. Fama and French find that the intercept is greater than the average risk free rate and the slope, which is the coefficient of the beta, is less than the average excess market return.

Figure 5.2: Average annualized monthly returns versus betas for value weighted portfolios based on pre-ranking betas, 1928–2003.



Fama and French (2004)

It is seen from Figure 5.2 that the relationship between the average monthly return and beta is roughly linear as the CAPM predicts. However, the returns on the low beta portfolios are too high and the returns on the high beta portfolios are too low. This may be a serious problem in terms of performance evaluation, because even passive funds that invest in low beta securities can produce positive alpha estimates in CAPM tests, despite the fact that their managers make no effort to pick individual stocks (Fama and French, 2010).

Although the CAPM receives a lot of criticism, it is still being widely used in many financial applications. Mullins (1982) argues that the true tests of the CAPM lie in the validity and usefulness of its predictions. Therefore, following the literature on mutual fund performance evaluation, we build our analysis on the CAPM and its extensions.

5.3. Tests for Selectivity

In order to estimate security selection ability of pension fund managers, we employ single- and multi-factor models. Our single-factor model can be formalized as follows:

$$r_{it} - r_{ft} = \alpha_i + \beta_i(r_{mt} - r_{ft}) + \varepsilon_{it} \tag{5.2}$$

where r_{it}, r_{ft} and r_{mt} are returns in month *t* for the fund *i*, the risk free rate and the benchmark, respectively. α_i is the security selection ability of the fund *i*'s manager and known as Jensen's alpha. β_i is the systematic risk of fund *i*, and ε_{it} is the error term. It must be noted that α_i represents the deviation from the SML. Hence, it is interpreted as the value added by the manager. The efficient markets hypothesis predicts that the intercept in (5.2) cannot be statistically different from zero. Therefore, a significantly positive alpha indicates existence of skilled managers who selects undervalued securities. On the other hand, a significantly negative alpha means the manager fails to cover his expenses.

A private pension fund in Turkey generally invests in a variety of securities. Therefore, it is very important to check the robustness of the conclusions from the single-factor model. For this reason, we employ a multi-factor model to estimate pension fund managers' security selection ability. Our multi-factor model reads as:

$$r_{it} - r_{ft} = \alpha_i + \beta_{i1}(r_{m1,t} - r_{ft}) + \beta_{i2}(r_{m2,t} - r_{ft}) + \cdots + \beta_{in}(r_{mn,t} - r_{ft}) + \varepsilon_{it} \tag{5.3}$$

In this model, the interpretation of the alpha and betas is the same as in the single-factor model. If a benchmark is relevant in explaining the excess return in fund *i*, its beta is significantly different from zero. Otherwise it should be dropped out of the model. In our multi-factor models, the number of benchmarks employed, n, is either 3 or 4 depending on the fund group under investigation (see Table 4.2).

5.4. Market Timing Tests

A manager with market timing ability changes the risk exposure of the assets in his portfolio according to his expectations of bull and bear markets. If the manager expects a rise in the general price level in the market, he will sell securities with low betas and buy securities with higher sensitivity to the market. If a fall is expected in the general price level, the manager reduces the systematic risk in his portfolio by shifting from more to less volatile securities (Treynor and Mazuy, 1966).

Jensen (1968) argues that if the manager is unable to forecast general market movements (macro-forecasting), the estimate of his ability to increase returns by choosing undervalued securities (micro-forecasting) will be unbiased. On the other hand, if the manager has macro-forecasting ability, the estimate of alpha will be biased upward since extra returns earned on the portfolio will be partly due to the manager's market timing ability. However, Grant (1977) argues that Jensen's work contains a mathematical error and a conceptual problem. He shows the estimate of security selection ability will be biased downward in the presence of macro-forecasting skills.

In the general CAPM framework, a portfolio's excess return is a linear function of the excess return on the market portfolio. However, in successful practices of macro-forecasting, when the general market price goes up, the value of the portfolio rises even more. Likewise, when the general price level in the market falls, the value of the portfolio decreases less than a linear relationship suggests. To account for this non-linearity, Treynor and Mazuy (1966) introduced a quadratic term to equation (5.2). Treynor and Mazuy's model reads as:

$$r_{it} - r_{ft} = \alpha_i + b_i (r_{mt} - r_{ft}) + \gamma_i (r_{mt} - r_{ft})^2 + \varepsilon_{it} \tag{5.4}$$

Equation (5.4) can also be written as:

$$r_{it} - r_{ft} = \alpha_i + (b_i + \gamma_i (r_{mt} - r_{ft}))(r_{mt} - r_{ft}) + \varepsilon_{it} \tag{5.5}$$

It can be seen from equation (5.5) that the systematic risk, β, of the portfolio is $b_i + \gamma_i (r_{mt} - r_{ft})$. Hence, β changes according to the variation in the excess market return. If the manager has no macro-forecasting ability, γ_i is zero and equation (5.5) shrinks down to equation (5.2). However, a positive γ_i implies the manager has the market timing skills. As in our single- and multi-factor models α_{i} is interpreted as the security selection ability of the manager.

Another model developed to measure macro-forecasting skills of the fund managers is by Henriksson and Merton (1981). In their model, the risk of the portfolio changes between two betas in up and down markets. The model reads as:

$$r_{it} - r_{ft} = \alpha_i + \beta_i (r_{mt} - r_{ft}) + \gamma_i Max[-(r_{mt} - r_{ft}) \,;\, 0] + \varepsilon_{it} \tag{5.6}$$

From equation (5.6), it can be seen that in bull markets the systematic risk of the portfolio is β_i, and in bear markets the risk exposure is $\beta_i - \gamma_i$. Hence, a manager who has market timing skills switch between two levels of risk exposure in up and down markets. In this way, the manager increases the sensitivity of his portfolio when he expects a rise in the general price level in the market and decreases the beta when there is a downward trend in the market. Therefore, a positive γ_i indicates the manager has macro-forecasting ability and, if γ_i is zero there is no market timing ability and equation (5.6) reduces to equation (5.2). As in the Treynor and Mazuy model, α_i captures the security selection ability of the fund managers.

Following Weigel (1991), we employ an extension of the Henriksson and Merton model to test the timing abilities of the pension fund managers in our sample. Specifically, we add a perfect market timing option to our multi-factor model in equation (5.3). Formally, our model reads as:

$$r_{it} - r_{ft} = \alpha_i + \beta_{i1}(r_{m1,t} - r_{ft}) + \beta_{i2}(r_{m2,t} - r_{ft}) + \cdots + \beta_{in}(r_{mn,t} - r_{ft}) + \gamma_i Z + \varepsilon_{it} \tag{5.7}$$

where Z is the perfect market timing option embedded in the manager's process and is given by:

$$Z = Max[(r_{m1,t} - r_{ft}), (r_{m2,t} - r_{ft}), \ldots, (r_{mn,t} - r_{ft}), 0] \tag{5.8}$$

A clairvoyant market timer always invests 100% of his portfolio in the best performing asset class. If all of the n investment options generate a negative excess return, the perfect market timer sells his portfolio and invests in the risk free asset only. In that case, he realizes a zero excess return. As a result, a clairvoyant market timer will never have a negative excess return. In equation (5.7), γ_i represents the fraction of the perfect market timing option delivered by the manager and is bounded by $[-1, +1]$.[20] The interpretations of the alpha and betas are the same as in our multi-factor model.

5.5. Performance Persistence Tests

In order to measure the persistence in pension funds' performances we mainly follow the methodology in Christensen (2005). First, for each fund in our sample, we estimate a 12th order autocorrelation structure for returns. If the estimates for the autocorrelation coefficients are positive and significant, we have reason to suspect that the returns are persistent. We calculate Ljung-Box Q test statistics for the average autocorrelation coefficients in each fund group. The null hypothesis in this test is that the autocorrelation coefficients from lag 1 to lag 12 are jointly insignificant. The Ljung-Box Q test statistic is given as:

$$Q = T(T+2)\sum_{k=1}^{12}\left(\frac{p(k)^2}{(T-k)}\right) \tag{5.9}$$

where T is the sample size and $p(k)$ is the autocorrelation coefficient at lag k. The resulting test statistics has a χ^2-distribution with 12 degrees of freedom.

In order to measure medium-term persistence, we employ a Winner-Loser test. In this test, we combine the balanced funds and flexible funds into a new group due to the insufficient number of balanced funds in our sample. Firstly, we divide our sample period into three sub-periods of almost equal length. Specifically, our sub-periods are July, 2004 – December, 2006; December, 2006 – April, 2009; and April, 2009 – August, 2011. Next, for each sub-period we determine winner and loser funds. A fund is labeled as a winner (W) fund if its return in a sub-period is equal to or higher than the median return in its group. Otherwise, it is identified as a loser (L) fund. Then, we form two-way tables and calculate log-odds-ratios. The log-odds-ratio (LOR) for two subsequent sub-periods is given as:

[20] See Weigel, Eric. J., 1991, The Performance of Tactical Asset Allocation, Financial Analysts Journal, 47, p.63-71.

$$LOR = ln\left(\frac{WW.LL}{WL.LW}\right) \tag{5.10}$$

In (5.10), WW (LL) represents the number of funds that are winners (losers) in both sub-periods, while WL (LW) stands for the number of funds that are winners (losers) in the previous sub-period and losers (winners) in the current sub-period.

Under the null hypothesis of no performance persistence, LOR is zero. If persistence does not exist, the terms $WW.LL$ and $WL.LW$ are expected to be equal to each other because the state in the current sub-period is independent from the state in the previous sub-period. If there is positive persistence, the term $WW.LL$ is expected to be greater than $WL.LW$. In that case, LOR is positive. Likewise, if there exists a negative persistence (reversal effect) in performance, it is expected that the term $WL.LW$ is bigger than $WW.LL$. Therefore, a negative LOR statistic is consistent with a negative persistence. We can obtain a t-statistic to test the significance of the LOR statistic. The t-statistic approximately follows standard normal distribution and is given by $\frac{LOR}{\sigma_{LOR}}$, where[21]

$$\sigma_{LOR} = \sqrt{\frac{1}{WW} + \frac{1}{WL} + \frac{1}{LW} + \frac{1}{LL}} \tag{5.11}$$

If all funds in the current sub-period have the same identification as the previous sub-period so that there are no reversals between the states (W) and (L), the term $WL.LW$ is zero. In that case, LOR statistic cannot be calculated. Instead, we perform a χ^2-test of independence. The χ^2 test statistic is given by:

$$\chi^2 = \sum_{WW,WL,LW,LL}\left[\frac{(F_0 - F_e)^2}{F_e}\right] \tag{5.12}$$

where F_0 is the observed frequency and F_e is the expected frequency for each cell in the two-way table. Since we have two rows and two columns in our two-way tables, the χ^2 test statistic has only 1 degree of freedom. Therefore, we need to check the robustness of our results. For this

[21] See Christensen, M., 2005, Danish Mutual Fund Performance – Selectivity, Market Timing and Persistence, Working Paper, Finance Research Group, Aarhus School of Business.

reason, we employ also a parametric approach to measure the medium-term persistence. As in the Winner-Loser test, we divide our sample period into three sub-periods and treat balanced and flexible funds as a single group. The sub-periods are identical to those in the Winner-Loser test. Following Christensen (2005), we run a cross-sectional regression. Specifically, we regress returns in a sub-period onto the returns from the preceding sub-period. The regression equation is as follows:

$$r_2 = a_0 + a_1 r_1 + \varepsilon \tag{5.13}$$

where $r_1$and r_2 represent the returns from the former and the latter sub-periods, respectively. Equation (5.13) estimates how much explanatory power the returns from the previous sub-period have on the returns in the subsequent sub-period. A positive and significant estimate of $a_1$is consistent with positive persistence, while a negatively significant estimate indicates a reversal effect in performance. Equivalently, under the null hypothesis of no performance persistence, $a_1$is estimated to be zero.

Finally, we adopt a time-series approach to measure the short-term persistence. For each fund group, we construct equally weighted portfolios of top-performing funds and worst-performing funds. We rebalance the portfolios monthly so that a portfolio of top-performers always comprises only 25% of the best performing funds from the previous month. Likewise, a portfolio of worst-performers always includes 25% of the worst performing funds from the most recent month. As in the Winner-Loser test and the cross sectional regression, we treat balanced and flexible funds as a single group. As a result, we have five fund groups and ten portfolios in total. For each portfolio, we employ our multi-factor model, given in equation (5.3). If hot hands phenomenon exists, we expect alphas from the best-performing portfolios to be significantly positive. Likewise, if bad performance persists in the short-term, alphas from the worst performing portfolios are expected to be significantly negative.

6. Empirical Findings

In this section, we present our results concerning security selection and market timing abilities of Turkish private pension fund managers. We also discuss our findings on performance persistence. All the tests are based on returns after expenses.

Before measuring the performances at the individual fund level, we construct value weighted portfolios for six fund categories and for all 65 funds analyzed. In total, we have time series returns data for seven value weighted portfolios, six benchmarks and the risk free rate. As can be seen in Table 6.1, among other portfolios, the value weighted portfolio for equity pension funds has the highest average monthly return of 171 basis points, net of expenses. However, its standard deviation is much higher than the other portfolios. While all other portfolios have standard deviations under 3%, the value weighted equity portfolio's standard deviation is 8.1%. The value weighted equity portfolio also yields the highest average monthly excess return of 63 basis points, net of expenses. Also, among excess returns for other portfolios, it has a much higher variation. It seems, equity pension funds generate the highest average monthly excess net returns with the highest amount of risk over the analysis period from July, 2004 to August, 2011. It can be noted that a similar relationship between ISE National 100 and other indices exists, for both raw returns and excess returns. It can also be seen in Table 6.1 that, the value weighted eurobond portfolio yields the lowest average monthly return which is 78 basis points, net of expenses. Its excess return is also the lowest among the other portfolios (-30 basis points).

Table 6.1: Means and standard deviations of monthly net returns , from July, 2004 to August, 2011.

Using market values of the funds, we construct weighted portfolios for 65 funds in our sample as well as for fund groups. This table presents means and standard deviations of raw and excess returns of value weighted portfolios as well as the benchmarks and the risk free rate of return (KYD Bond Index 30 Days (TL)).

	raw returns (%)		**excess returns (%)**	
value weighted portfolios	**mean**	**sd**	**mean**	**sd**
money market	0.96	0.38	-0.12	0.07
fixed income	1.23	1.11	0.15	0.98
flexible	1.25	2.60	0.17	2.58
balanced	1.27	2.93	0.19	2.92
equity	1.71	8.10	0.63	8.12
eurobond	0.78	2.58	-0.30	2.59
all	1.17	1.35	0.09	1.28
	raw returns (%)		**excess returns (%)**	
indices	**mean**	**sd**	**mean**	**sd**
KYD General Bond Index (TL)	1.36	1.20	0.28	1.10
KYD O/N Gross Repo Index (TL)	1.11	0.42	0.03	0.11
KYD Eurobond Index (USD-TL)	1.10	3.29	0.02	3.31
KYD Eurobond Index (EUR-TL)	1.00	3.87	-0.08	3.88
ISE National 100	1.67	8.81	0.60	8.83
KYD Bond Index 30 Days (TL)	1.08	0.36	0.00	0.00
KYD Bond Index 91 Days (TL)	1.19	0.49	0.11	0.23

We estimate alphas for the value weighted portfolios by equation (5.3) using Newey-West corrected standard errors and OLS procedure. We regress excess returns of these portfolios on the excess returns of all six benchmarks that we use in this study. The results are provided in Table 6.2. The weighted portfolios of money market funds, fixed income funds, eurobond funds and the aggregate portfolio of all 65 funds yield significantly negative alphas at 5% level. On the other hand, the portfolio of equity funds realizes a positive intercept term, though not significant. Also, the portfolios of flexible funds and balanced funds generate insignificant alphas. As a result, no value weighted portfolios (neither the aggregate portfolio, nor any portfolios for fund groups) can beat the passive benchmarks.

Table 6.2: Performances of value weighted portfolios against passive benchmarks

We estimate our multi-factor model given in equation (5.3) for value weighted portfolios using OLS procedure and Newey-West corrected standard errors. The model is given by:

$$r_{it} - r_{ft} = \alpha_i + \beta_{i1}(r_{m1,t} - r_{ft}) + \beta_{i2}(r_{m2,t} - r_{ft}) + \cdots + \beta_{in}(r_{mn,t} - r_{ft}) + \varepsilon_{it} \ .$$

This table reports the estimates for the intercept term (α) and the coefficients for the six benchmarks used. Next to each estimate, the associated p-values are presented. α represents the value added by security selection and β's are interpreted as the sensitivities to different market proxies. A * indicates significance at 5% level.

value weighted portfolios	α	p-value	β_KYD Gen. Bond Index (TL)	p-value	β_KYD O/N Gross Repo Index (TL)	p-value	β_KYD Eurobond Index (USD-TL)	p-value	β_KYD Eurobond Index (EUR-TL)	p-value	β_ISE National 100	p-value	β_KYD Bond Index 91 Days (TL)	p-value
money market	-0.14%*	0	0.02*	0.05	0.32*	0	-0.00	0.29	0.00	0.73	0.00	0.38	0.05	0.24
fixed income	-0.16%*	0	0.68*	0	0.52	0.39	0.01	0.76	-0.01	0.72	0.01	0.38	0.92*	0.01
flexible	-0.13%	0.22	0.48*	0.01	0.45	0.61	0.05	0.24	-0.00	0.88	0.24*	0	0.05	0.93
balanced	-0.17%	0.21	0.51*	0.01	0.07	0.95	0.02	0.71	0.11	0.06	0.28*	0	0.46	0.50
equity	0.09%	0.75	0.20	0.59	-1.67	0.45	0.03	0.74	0.00	0.99	0.87*	0	0.18	0.88
eurobond	-0.32%*	0.01	0.25	0.33	-0.15	0.89	0.49*	0	0.23*	0	-0.03	0.12	-0.15	0.83
all	-0.15%*	0.01	0.44*	0	0.15	0.76	0.03	0.12	0.01	0.47	0.10*	0	0.52	0.10

6.1. Security Selection Results

We employ single- and multi-factor models to measure security selection abilities of pension fund managers. In order to account for potential heteroskedasticity and serial autocorrelation problems in the errors, Newey-West corrected standard errors are used in both models. The benchmark selection procedure is as explained in Section 4.

For the single-factor analyses, we estimate equation (5.2) by OLS. We present the results in Table 6.2. All money market funds and the value weighted portfolio constructed for this group have negative and significant Jensen's alphas. However, these results must be interpreted carefully as seven funds in this group had insignificant betas meaning that the single-factor model does not fit well for money market funds. We can see from Table 6.2 that the single-factor model fits better for fixed income funds. It can be concluded that, in general, alphas for the fixed income funds are either significantly negative or insignificant around zero. In the flexible funds group, only one fund has shown security selection skills, while other funds have either negative or insignificant alphas. In our sample, we have two balanced funds. In general, balanced funds incorporate short-term bonds and reverse repos in their portfolios to balance the risk undertaken by investing in stocks. According to our results in Table 6.2, this strategy did not generate abnormal returns for the balanced funds in our sample, over the analysis period. It can be seen that, alphas for the balanced funds are not statistically different from zero. For equity funds, we have a similar conclusion regarding the security selection abilities of the fund managers as 10 funds in this group have insignificant alphas. However, one fund has shown stock picking skills as evidenced by positive and significant estimate for the intercept in equation (5.2). Finally, the findings for the eurobond funds indicate that, these funds' managers failed to generate abnormal returns by selecting undervalued securities, over the analysis period. Moreover, five of them did not cover the cost of their expenses as indicated by negatively significant alphas.

Table 6.3: Results of the single-factor analyses

In the single-factor analyses, we estimate equation (5.2) using OLS procedure and Newey-West corrected standard errors. The model is as follows:

$$r_{it} - r_{ft} = \alpha_i + \beta_i(r_{mt} - r_{ft}) + \varepsilon_{it.}$$

The portfolio structures and investment strategies are different between fund groups. Hence, we use specific benchmarks across the groups. This table reports the estimates for α and β coefficients as well as the associated p-values. α represents the value added by security selection and β coefficient is interpreted as the sensitivity of the fund to a market proxy. A * indicates significance at 5% level.

money market funds	**α**	**p-value**	**β_(MM_composite)**	**p-value**
AE1	-0.12%*	0.00	0.04	0.15
AH2	-0.14%*	0.00	0.04*	0.02
ANK	-0.12%*	0.00	0.03	0.19
AVL	-0.13%*	0.00	0.02	0.41
BEL	-0.20%*	0.00	0.03	0.15
FEL	-0.10%*	0.00	0.05*	0.00
FEP	-0.29%*	0.00	-0.03	0.22
FHL	-0.25%*	0.00	-0.01	0.86
GEL	-0.10%*	0.00	0.06*	0.01
VEL	-0.13%*	0.00	0.00	0.96
YEL	-0.26%*	0.00	-0.09*	0.04
YEP	-0.13%*	0.00	0.07*	0.00
value weighted portfolio	-0.13%*	0.00	0.04*	0.00

fixed income funds	**α**	**p-value**	**β_(KYD Gen. Bond Index (TL))**	**p-value**
AE2	-0.09%	0.18	0.85*	0.00
AEK	-0.02%	0.38	0.72*	0.00
AH1	-0.05%	0.40	0.80*	0.00
ANG	-0.18%*	0.02	0.85*	0.00
ATK	-0.35%*	0.00	1.11*	0.00
AVK	-0.06%*	0.05	0.74*	0.00
BEK	-0.09%*	0.05	0.60*	0.00
FEK	-0.33%*	0.01	0.90*	0.00
FHK	0.17%*	0.00	0.21*	0.04
GEK	-0.07%	0.35	0.91*	0.00
GKB	-0.22%*	0.03	0.75*	0.00
HS1	-0.02%	0.82	0.63*	0.00
VEK	-0.16%*	0.01	0.63*	0.00
YEK	-0.09%	0.07	0.90*	0.00
value weighted portfolio	-0.08%	0.14	0.81*	0.00

Table 6.3: Results of the single-factor analyses (continued)

flexible funds	**α**	**p-value**	**β_(FL_composite)**	**p-value**
AE3	-0.23%	0.12	1.23*	0.00
AEG	0.09%*	0.01	0.09*	0.00
AH0	0.15%	0.65	1.74*	0.00
AH8	-0.04%	0.46	0.06*	0.00
AH9	-0.09%	0.51	1.14*	0.00
ATE	-0.32%*	0.02	1.64*	0.00
AVE	-0.17%	0.35	0.92*	0.00
BEE	-0.17%	0.15	0.79*	0.00
FEE	-0.52%*	0.00	1.19*	0.00
FHE	0.18%	0.43	0.61*	0.00
GED	-0.28%	0.49	-0.93*	0.00
GHE	-0.35%*	0.00	1.23*	0.00
VEE	-0.19%	0.11	0.70*	0.00
YEE	-0.13%	0.41	0.77*	0.00
value weighted portfolio	-0.18%	0.09	1.02*	0.00

balanced funds	**α**	**p-value**	**β_(BA_composite)**	**p-value**
ANE	-0.11%	0.19	0.74*	0.00
AVD	-0.14%	0.28	0.64*	0.00
value weighted portfolio	-0.09%	0.35	0.68*	0.00

equity funds	**α**	**p-value**	**β_(ISE National 100)**	**p-value**
AEB	0.12%	0.42	0.90*	0.00
AEH	-0.24%	0.26	0.88*	0.00
AH5	0.33%	0.11	0.91*	0.00
AHB	0.37%	0.11	0.90*	0.00
ANS	0.42%*	0.01	0.89*	0.00
AVH	0.11%	0.60	0.88*	0.00
BEH	-0.29%	0.23	0.83*	0.00
FHH	0.64%	0.07	0.88*	0.00
GEH	0.05%	0.73	0.88*	0.00
VEH	0.11%	0.66	0.85*	0.00
YEH	0.12%	0.41	0.90*	0.00
value weighted portfolio	0.10%	0.48	0.88*	0.00

Table 6.3: Results of the single-factor analyses (continued)

eurobond funds	**α**	**p-value**	**β_(EU_composite)**	**p-value**
AE6	-0.39%	0.10	0.70*	0.00
AE7	-0.28%	0.11	0.87*	0.00
AH3	-0.17%	0.21	0.68*	0.00
AH4	-0.27%*	0.04	0.86*	0.00
AVG	-0.23%*	0.01	0.72*	0.00
BED	-0.50%*	0.00	0.74*	0.00
FEB	-0.36%	0.17	0.77*	0.00
FED	-0.30%	0.14	0.74*	0.00
GHG	-0.15%	0.25	0.70*	0.00
VET	-0.17%	0.13	0.69*	0.00
YGE	-0.33%*	0.04	0.85*	0.00
YKK	-0.32%*	0.04	0.67*	0.00
value weighted portfolio	-0.28%*	0.00	0.72*	0.00

For the multi-factor analyses, equation (5.3) is estimated by OLS. It can be seen from Table 6.4 that, the multi-factor model is a better fit for the returns data from money market funds. Unlike the single-benchmark analysis, we have at least one significant beta for most of the money market funds. Only 3 funds in this group have insignificant coefficients for all benchmarks. However, the general conclusion about the security selection ability of the money market funds does not change. As in the single-factor analysis, each fund in this group yields a negative and significant alpha. We see from Table 6.4 that 11 out of 14 fixed income funds have significantly negative alphas and one fund generates a significantly positive estimate for the intercept in equation (5.3). This fund also produces a significant alpha in our single-factor analysis. However, these results should be interpreted carefully as the multi-factor model does not produce significant estimates for any coefficients for this fund. In the flexible funds group, 6 funds have negative and significant alphas. The remaining flexible funds also do not seem to be able to realize abnormal returns from selecting undervalued securities. As in our single-benchmark analysis, the alphas for the balanced funds in our multi-factor model are not statistically different from zero. It is interesting to note that an equity pension fund, whose alpha is not statistically different from zero in the single-factor analysis, yields a positive and significant estimate for the intercept term in equation (5.3). Also, it is found that one fund has a negative alpha while the remaining ten equity pension funds do not generate alphas that are statistically different from zero in our multi-factor analysis. Lastly, we find that eight eurobond funds produce negative and significant alphas and the remaining four eurobond funds yield statistically insignificant alphas when we estimate the model given in equation (5.3).

Table 6.4: Results of the multi-factor analyses

In the multi-factor analyses, we estimate equation (5.3) using OLS procedure and Newey-West corrected standard errors. The model is as follows:

$$r_{it} - r_{ft} = \alpha_i + \beta_{i1}(r_{m1,t} - r_{ft}) + \beta_{i2}(r_{m2,t} - r_{ft}) + \cdots + \beta_{in}(r_{mn,t} - r_{ft}) + \varepsilon_{it}$$

The portfolio structures and investment strategies are different between fund groups. Hence, we use specific sets of benchmarks across the groups. This table reports the estimates for α and β coefficients as well as the associated p-values. α represents the value added by security selection and β's are interpreted as the sensitivities to different market proxies. A * indicates significance at 5% level.

money market funds	**α**	**p-value**	**β_KYD O/N Gross Repo Index (TL)**	**p-value**	**β_KYD Bond Index 91 Days (TL)**	**p-value**	**β_KYD Gen. Bond Index (TL)**	**p-value**
AE1	-0.14%*	0.00	0.54*	0.00	0.13	0.10	0.00	0.81
AH2	-0.16%*	0.00	0.42*	0.00	0.07	0.17	0.01	0.30
ANK	-0.14%*	0.00	0.49*	0.00	0.02	0.22	0.01	0.10
AVL	-0.14%*	0.00	0.20	0.24	0.06	0.31	0.00	0.76
BEL	-0.20%*	0.00	0.15	0.39	-0.05	0.49	0.02	0.13
FEL	-0.11%*	0.00	0.49*	0.00	0.14*	0.01	0.01	0.09
FEP	-0.30%*	0.00	0.67*	0.00	-0.09	0.14	0.02	0.26
FHL	-0.18%*	0.00	0.18*	0.03	-0.02	0.93	0.05*	0.02
GEL	-0.11%*	0.00	0.34*	0.02	0.04	0.52	0.02*	0.02
VEL	-0.14%*	0.00	0.21	0.21	-0.08	0.13	0.01	0.33
YEL	-0.24%*	0.00	0.14	0.57	-0.46*	0.00	0.03*	0.01
YEP	-0.14%*	0.00	0.32*	0.00	0.09*	0.01	0.02*	0.04
value weighted portfolio	-0.14%*	0.00	0.33*	0.01	0.04	0.28	0.01	0.14

fixed income funds	**α**	**p-value**	**β_KYD Gen. Bond Index (TL)**	**p-value**	**β_KYD Bond Index 91 Days (TL)**	**p-value**	**β_KYD O/N Gross Repo Index (TL)**	**p-value**	**β_ISE National 100**	**p-value**
AE2	-0.19%*	0.00	0.69*	0.00	1.19*	0.00	0.50	0.41	0.00	0.65
AEK	-0.04%	0.07	0.61*	0.00	0.63	0.09	-0.02	0.95	0.01	0.28
AH1	-0.13%*	0.01	0.63*	0.00	0.99*	0.00	0.40	0.46	0.01	0.06
ANG	-0.28%*	0.00	0.63*	0.00	1.27*	0.00	0.52	0.25	0.02	0.08
ATK	-0.36%*	0.00	0.90*	0.00	1.21	0.07	-1.32	0.08	0.00	0.57
AVK	-0.07%*	0.03	0.70*	0.00	0.13	0.74	0.13	0.74	0.01	0.20
BEK	-0.17%*	0.00	0.50*	0.00	0.76*	0.00	0.65	0.17	0.00	0.38
FEK	-0.33%*	0.00	0.80*	0.01	0.47	0.28	-0.66	0.52	0.00	0.50
FHK	0.19%*	0.00	0.07	0.82	1.05	0.34	1.11	0.40	0.01	0.42
GEK	-0.17%*	0.00	0.76*	0.00	1.11*	0.00	0.75	0.06	0.00	0.46
GKB	-0.21%*	0.02	0.55*	0.00	0.44	0.16	-0.59	0.46	0.03*	0.00
HS1	-0.03%	0.69	0.67*	0.00	-0.36	0.54	0.88	0.24	0.01	0.26
VEK	-0.21%*	0.00	0.50*	0.00	0.80	0.10	0.14	0.86	0.01	0.41
YEK	-0.17%*	0.00	0.81*	0.00	0.71*	0.00	0.60	0.19	0.00	0.87
value weighted portfolio	-0.16%*	0.00	0.68*	0.00	0.93*	0.00	0.50	0.27	0.01	0.20

Table 6.4: Results of the multi-factor analyses (continued)

flexible funds	α	p-value	β_KYD Gen. Bond Index (TL)	p-value	β_ISE National 100	p-value	β_KYD O/N Gross Repo Index (TL)	p-value	β_KYD Bond Index 91 Days (TL)	p-value
AE3	-0.21%	0.10	0.39*	0.02	0.29*	0.00	0.61	0.42	0.95*	0.01
AEG	0.00%	0.72	0.18*	0.00	0.00	0.91	0.34	0.30	0.77*	0.02
AH0	0.23%	0.47	0.13	0.75	0.46*	0.00	1.45	0.36	1.46	0.10
AH8	-0.17%*	0.00	0.06	0.11	0.00	0.37	0.75*	0.00	0.93*	0.00
AH9	0.00%	0.96	0.47*	0.00	0.27*	0.00	-0.72	0.32	0.21	0.62
ATE	-0.22%*	0.00	0.54*	0.00	0.40*	0.00	0.57	0.59	1.34	0.13
AVE	-0.08%	0.71	0.28	0.27	0.22*	0.00	-0.93	0.42	0.48	0.43
BEE	-0.25%*	0.01	-0.07	0.55	0.20*	0.00	0.60	0.49	2.22*	0.00
FEE	-0.46%*	0.00	0.01	0.99	0.31*	0.00	0.19	0.89	2.45	0.23
FHE	0.55%	0.20	0.11	0.82	0.17*	0.00	6.82	0.23	1.15	0.72
GED	0.08	0.75	-1.44*	0.01	-0.13*	0.01	-8.32*	0.00	0.55	0.67
GHE	-0.33%*	0.00	0.62*	0.00	0.28*	0.00	1.21	0.09	0.15	0.69
VEE	-0.30%*	0.00	0.18	0.34	0.16*	0.00	0.85	0.27	1.72*	0.00
YEE	-0.08%	0.44	0.85*	0.00	0.14*	0.00	-0.04	0.96	-1.07	0.22
value weighted portfolio	-0.12%	0.20	0.46*	0.00	0.24*	0.00	0.03	0.95	0.18	0.70

balanced funds	α	p-value	β_KYD Gen. Bond Index (TL)	p-value	β_ISE National 100	p-value	β_KYD O/N Gross Repo Index (TL)	p-value
ANE	-0.08%	0.37	0.51*	0.00	0.29*	0.00	-1.39	0.13
AVD	-0.13%	0.52	0.54*	0.03	0.25*	0.00	-1.42	0.19
value weighted portfolio	-0.10%	0.54	0.56*	0.00	0.26*	0.00	-0.87	0.38

equity funds	α	p-value	β_ISE National 100	p-value	β_KYD Gen. Bond Index (TL)	p-value	β_KYD O/N Gross Repo Index (TL)	p-value
AEB	0.15%	0.46	0.89*	0.00	0.15	0.46	-2.63	0.12
AEH	-0.33%*	0.04	0.87*	0.00	0.18	0.46	-3.00	0.09
AH5	0.33%	0.08	0.89*	0.00	0.21	0.42	-1.69	0.28
AHB	0.20%	0.38	0.87*	0.00	0.53*	0.03	-0.82	0.79
ANS	0.34%	0.12	0.86*	0.00	0.36	0.08	-0.41	0.81
AVH	0.07%	0.75	0.88*	0.00	0.06	0.82	-2.46	0.21
BEH	-0.22%	0.41	0.81*	0.00	0.26	0.32	-4.01	0.09
FHH	0.95%*	0.02	0.90*	0.00	-0.20	0.61	4.74	0.54
GEH	-0.01%	0.96	0.87*	0.00	0.20	0.37	0.27	0.85
VEH	0.13%	0.60	0.83*	0.00	0.22	0.44	-2.27	0.27
YEH	0.15%	0.38	0.89*	0.00	0.22	0.28	-2.59*	0.05
value weighted portfolio	0.11%	0.50	0.87*	0.00	0.22	0.29	-1.91	0.13

Table 6.4: Results of the multi-factor analyses (continued)

eurobond funds	α	p-value	β_KYD Eurobond Index (USD-TL)	p-value	β_KYD Eurobond Index (EUR-TL)	p-value	β_KYD Gen. Bond Index (TL)	p-value
AE6	0.01%	0.95	0.78*	0.00	-0.09	0.14	-1.58*	0.00
AE7	-0.22%*	0.02	0.01	0.77	0.77*	0.00	-0.09	0.60
AH3	-0.24%*	0.00	0.77*	0.00	-0.01	0.90	0.14	0.60
AH4	-0.19%*	0.00	0.03	0.15	0.75*	0.00	-0.14	0.43
AVG	-0.40%*	0.01	0.41*	0.00	0.35*	0.00	0.67*	0.03
BED	-0.16%	0.18	0.51*	0.00	0.20*	0.00	-1.26*	0.00
FEB	-0.04%	0.76	0.65*	0.00	0.10	0.16	-1.28*	0.00
FED	0.00%	0.99	0.67*	0.00	0.07	0.27	-1.21*	0.00
GHG	-0.33%*	0.01	0.78*	0.00	0.02	0.64	0.50	0.11
VET	-0.44%*	0.00	0.60*	0.00	0.18*	0.05	0.92*	0.00
YGE	-0.45%*	0.00	0.01	0.87	0.78*	0.00	0.61*	0.01
YKK	-0.46%*	0.01	0.64*	0.00	0.12	0.19	0.60*	0.03
value weighted portfolio	-0.33%*	0.00	0.51*	0.00	0.24*	0.00	0.14	0.45

It can be noted that, our empirical results from the multi-factor models are consistent with our findings from the single-factor models. In general, the pension fund managers failed to earn abnormal profits by selecting undervalued securities, over the analysis period. Moreover, many managers were not able to cover their expenses. This conclusion about Turkish pension fund managers' security selection skills is in line with findings in the literature on performances of actively managed US or European mutual funds.

6.2. Market Timing Results

In order to measure market timing abilities of pension fund managers, we estimate the model given in equation (5.7) by OLS. In order to account for potential serial autocorrelation and heteroskedasticity in the errors, we use Newey-West heteroskedasticity and autocorrelation consistent (HAC) standards errors so that our inference based on t-statistics and associated p-values is valid when we test for significance of the regression coefficients.

Table 6.5 presents the results. From the table, we see that 4 money market funds have shown significantly negative gammas over the analysis period. That means the managers of these funds have switched to low beta securities when there is an upward trend in the market, and to high beta securities when the general price level in the market is falling. This is called perverse market timing. It can also be seen that the remaining 8 funds in the money market group have insignificant gammas. Also, we find that, in the fixed income fund group, three funds display perverse market timing and the other funds have insignificant gammas around zero. A similar conclusion can be drawn about the market timing skills of flexible fund managers. The analysis revealed that 10 flexible funds have insignificant gammas and 3 funds exhibit perverse market timing. Moreover, 1 fund displays evidence of a significantly positive fraction of the perfect market timing option delivered by the manager. In addition, the two balanced pension funds in our sample do not display significant market timing. The general picture does not change for equity pension funds, either. In this group, none of the managers has shown macro-forecasting ability during the sample period. However, 6 funds generate significantly negative gammas. Lastly, for 11 eurobond pension funds, we do not find any evidence of significant market timing ability. The exception in this group is that 1 fund realizes a significantly positive gamma in our market timing test.

In summary, out of 65 funds in our sample, only two funds have displayed a significant fraction of the perfect market timing option. The more dramatic finding from our market timing test is that 17 funds in our sample have shown evidence of perverse market timing. Hence, it can be concluded that, Turkish pension fund managers, in general, do not have the ability to time the market.

Table 6.5: Results for market timing analyses

In the market timing analyses, we estimate equation (5.7) using OLS procedure and Newey-West corrected standard errors. The model is given by:

$$r_{it} - r_{ft} = \alpha_i + \beta_{i1}(r_{m1,t} - r_{ft}) + \beta_{i2}(r_{m2,t} - r_{ft}) + \cdots + \beta_{in}(r_{mn,t} - r_{ft}) + \gamma_i Z + \varepsilon_{it}$$

where Z is the perfect market timing option embedded in the manager's process and is given by:

$$Z = Max[(r_{m1,t} - r_{ft}), (r_{m2,t} - r_{ft}), \ldots, (r_{mn,t} - r_{ft}), 0]$$

The portfolio structures and investment strategies are different between fund groups. Hence, we use specific sets of benchmarks across the groups. This table reports the estimates for α, β and γ coefficients as well as the associated p-values. α represents the value added by security selection and β's are interpreted as the sensitivities to different market proxies. γ is the coefficient for the perfect market timing option. A * indicates significance at 5% level.

money market funds	**α**	**p-value**	**β_KYD O/N Gross Repo Index (TL)**	**p-value**	**β_KYD Bond Index 91 Days (TL)**	**p-value**	**β_KYD Gen. Bond Index (TL)**	**p-value**	**γ**	**p-value**
AE1	-0.14%*	0.00	0.54*	0.00	0.13	0.11	0.00	0.69	0.00	0.89
AH2	-0.16%*	0.00	0.42*	0.00	0.07	0.18	0.01	0.37	0.00	0.92
ANK	-0.13%*	0.00	0.49*	0.00	0.02	0.15	0.02*	0.05	-0.01	0.24
AVL	-0.12%*	0.00	0.20	0.21	0.06	0.22	0.02	0.11	-0.04*	0.00
BEL	-0.21%*	0.00	0.14	0.39	-0.06	0.47	0.01	0.55	0.02	0.49
FEL	-0.10%*	0.00	0.49*	0.00	0.15*	0.00	0.03*	0.00	-0.03*	0.00
FEP	-0.30%*	0.00	0.67*	0.00	-0.08	0.18	0.03*	0.01	-0.03*	0.00
FHL	-0.16%*	0.00	1.66*	0.02	0.03	0.81	0.09*	0.00	-0.08*	0.00
GEL	-0.11%*	0.00	0.34*	0.02	0.04	0.53	0.02	0.19	0.01	0.71
VEL	-0.12%*	0.00	0.22	0.19	-0.07	0.13	0.03	0.21	-0.03	0.21
YEL	-0.24%*	0.00	0.14	0.58	-0.46*	0.00	0.03	0.11	0.00	0.91
YEP	-0.14%*	0.00	0.32*	0.00	0.09*	0.01	0.02	0.07	-0.01	0.48
value weighted portfolio	-0.14%*	0.00	0.33*	0.01	0.04	0.27	0.02	0.13	-0.01	0.46

Table 6.5: Results for market timing analyses (continued)

fixed income funds	α	p-value	β_KYD Gen. Bond Index (TL)	p-value	β_KYD Bond Index 91 Days (TL)	p-value	β_KYD O/N Gross Repo Index (TL)	p-value	β_ISE National 100	p-value	γ	p-value
AE2	-0.15%*	0.00	0.69*	0.00	1.19*	0.00	0.46	0.46	0.01	0.23	-0.01	0.26
AEK	0.03%	0.51	0.61*	0.00	0.63	0.12	-0.09	0.79	0.02	0.07	-0.02*	0.03
AH1	-0.08%	0.09	0.63*	0.00	0.99*	0.00	0.35	0.53	0.02*	0.01	-0.01	0.19
ANG	-0.19%*	0.03	0.63*	0.00	1.26*	0.00	0.43	0.34	0.03	0.12	-0.03	0.29
ATK	-0.23%*	0.00	0.90*	0.00	1.16	0.08	-1.45	0.06	0.02	0.08	-0.03*	0.02
AVK	-0.15%*	0.00	0.71*	0.00	0.13	0.73	0.19	0.62	0.00	0.51	0.02	0.24
BEK	-0.13*	0.03	0.49*	0.00	0.76*	0.00	0.61	0.20	0.01	0.13	-0.01	0.46
FEK	-0.17%	0.09	0.80*	0.01	0.41	0.38	-0.82	0.46	0.02	0.21	-0.04	0.25
FHK	0.09%	0.34	0.08	0.78	0.91	0.44	0.83	0.47	0.00	0.99	0.02	0.39
GEK	-0.08%	0.22	0.76*	0.00	1.09*	0.00	0.67	0.09	0.01*	0.05	-0.02*	0.04
GKB	-0.38%*	0.04	0.56*	0.00	0.46	0.18	-0.44	0.59	0.01	0.54	0.04	0.17
HS1	-0.02%	0.77	0.67*	0.00	-0.37	0.54	0.87	0.26	0.01	0.35	0.00	0.91
VEK	-0.15%*	0.00	0.50*	0.00	0.79	0.11	0.08	0.92	0.01	0.23	-0.02	0.22
YEK	-0.12%*	0.00	0.81*	0.00	0.70*	0.00	0.56	0.25	0.01	0.23	-0.01	0.29
value weighted portfolio	-0.12%*	0.00	0.67*	0.00	0.93*	0.00	0.46	0.32	0.01*	0.03	-0.01	0.17

flexible funds	α	p-value	β_KYD Gen. Bond Index (TL)	p-value	β_ISE National 100	p-value	β_KYD O/N Gross Repo Index (TL)	p-value	β_KYD Bond Index 91 Days (TL)	p-value	γ	p-value
AE3	-0.11%	0.46	0.39*	0.03	0.31*	0.00	0.52	0.50	0.93*	0.01	-0.03	0.41
AEG	-0.01%	0.67	0.18*	0.00	0.00	0.53	0.36	0.28	0.77*	0.02	0.00	0.59
AH0	0.50%	0.38	0.11	0.77	0.49*	0.00	1.21	0.38	1.42	0.11	-0.07	0.73
AH8	-0.18%*	0.00	0.06	0.12	0.00	0.33	0.76*	0.00	0.93*	0.00	0.00	0.53
AH9	0.00%	0.97	0.47*	0.00	0.27*	0.00	-0.72	0.31	0.21	0.63	0.00	1.00
ATE	0.43%*	0.01	0.54*	0.00	0.47*	0.00	-0.07	0.95	1.08	0.27	-0.17*	0.00
AVE	0.13%	0.36	0.26	0.30	0.25*	0.00	-1.10	0.29	0.48	0.44	-0.05	0.37
BEE	-0.20%	0.16	-0.08	0.54	0.21*	0.00	0.56	0.52	2.21*	0.00	-0.01	0.74
FEE	0.30%	0.29	0.00	1.00	0.40*	0.00	-0.58	0.69	2.17	0.23	-0.20*	0.00
FHE	-0.47%	0.27	0.28	0.48	0.04	0.46	3.75	0.30	-0.35	0.89	0.24	0.09
GED	-1.02%*	0.00	-1.37*	0.01	-0.27*	0.00	-7.44*	0.00	0.57	0.65	0.28*	0.00
GHE	-0.06%	0.71	0.61*	0.00	0.31*	0.00	0.96	0.23	0.11	0.77	-0.07*	0.05
VEE	-0.06%	0.65	0.16	0.33	0.19*	0.00	0.62	0.39	1.69*	0.00	-0.06	0.20
YEE	0.10%	0.32	0.84*	0.00	0.17*	0.00	-0.20	0.80	-1.09	0.20	-0.04	0.10
value weighted portfolio	0.02%	0.92	0.45*	0.00	0.26*	0.00	-0.09	0.84	0.16	0.73	-0.03	0.48

balanced funds	α	p-value	β_KYD Gen. Bond Index (TL)	p-value	β_ISE National 100	p-value	β_KYD O/N Gross Repo Index (TL)	p-value	γ	p-value
ANE	0.16%	0.35	0.49*	0.00	0.32*	0.00	-1.62	0.08	-0.06	0.06
AVD	0.03%	0.85	0.53*	0.03	0.27*	0.00	-1.55	0.12	-0.04	0.45
value weighted portfolio	0.10%	0.50	0.54*	0.01	0.28*	0.00	-1.06	0.26	-0.05	0.23

Table 6.5: Results for market timing analyses (continued)

equity funds	α	p-value	β_ISE National 100	p-value	β_KYD Gen. Bond Index (TL)	p-value	β_KYD O/N Gross Repo Index (TL)	p-value	γ	p-value
AEB	0.74%*	0.03	0.97*	0.00	0.10	0.61	-3.21	0.08	-0.15*	0.01
AEH	0.03%	0.93	0.91*	0.00	0.18	0.45	-3.23	0.07	-0.09	0.17
AH5	0.67%	0.19	0.94*	0.00	0.19	0.48	-2.02	0.25	-0.09	0.51
AHB	0.48%	0.25	0.90*	0.00	0.53*	0.04	-1.12	0.70	-0.07	0.46
ANS	1.29%*	0.00	0.98*	0.00	0.29	0.19	-1.33	0.44	-0.24*	0.00
AVH	0.54%	0.11	0.94*	0.00	0.05	0.84	-2.87	0.18	-0.12*	0.05
BEH	0.80%	0.08	0.94*	0.00	0.18	0.47	-5.01*	0.05	-0.26*	0.01
FHH	1.11%	0.06	0.92*	0.00	-0.20	0.62	5.01	0.50	-0.04	0.76
GEH	0.64%*	0.05	0.95*	0.00	0.15	0.52	-0.36	0.79	-0.17*	0.03
VEH	0.66%	0.09	0.90*	0.00	0.18	0.53	-2.79	0.20	-0.14	0.07
YEH	0.74%*	0.05	0.96*	0.00	0.18	0.38	-3.16*	0.02	-0.15*	0.05
value weighted portfolio	0.66%*	0.05	0.94*	0.00	0.18	0.38	-2.43	0.08	-0.14*	0.03

eurobond funds	α	p-value	β_KYD Eurobond Index (USD-TL)	p-value	β_KYD Eurobond Index (EUR-TL)	p-value	β_KYD Gen. Bond Index (TL)	p-value	γ	p-value
AE6	-0.17%	0.58	0.75*	0.00	-0.11	0.06	-1.58*	0.00	0.08	0.39
AE7	-0.32%	0.06	-0.01	0.78	0.76*	0.00	-0.08	0.60	0.04	0.54
AH3	-0.05%	0.68	0.81*	0.00	0.02	0.68	0.14	0.61	-0.09	0.11
AH4	-0.42%*	0.00	-0.02	0.62	0.72*	0.00	-0.14	0.42	0.11*	0.02
AVG	-0.21%	0.27	0.45*	0.00	0.38*	0.00	0.67*	0.03	-0.09	0.48
BED	-0.30%	0.09	0.48*	0.00	0.18*	0.00	-1.26*	0.00	0.07	0.30
FEB	-0.23%	0.56	0.62*	0.00	0.08	0.30	-1.28*	0.00	0.08	0.55
FED	-0.24%	0.67	0.62*	0.00	0.04	0.56	-1.20*	0.00	0.10	0.59
GHG	-0.04%	0.76	0.83*	0.00	0.06	0.29	0.50	0.12	-0.13	0.17
VET	-0.05%	0.72	0.68*	0.00	0.24*	0.03	0.92*	0.00	-0.18*	0.05
YGE	-0.26%	0.19	0.05	0.35	0.81*	0.00	0.62*	0.01	-0.09	0.43
YKK	0.06%	0.88	0.75*	0.00	0.19	0.15	0.59*	0.03	-0.23	0.26
value weighted portfolio	-0.18%	0.31	0.54*	0.00	0.26*	0.00	0.14	0.46	-0.07	0.46

We analyze security selection and market timing abilities in separate models. We already discussed that, the security selection results from our single-factor model are consistent with the findings from the multi-factor model. However, for a complete overview, the alphas from the market timing models should be discussed in comparison with the results from the single- and multi-factor analyses. Table 6.1 presents the number of positive and negative alpha and gamma coefficients generated by different models employed to measure selectivity or market timing skills. In this table, the parentheses indicate the number of estimates that are significantly different from zero at 5% level. For example, it can be seen from Table 6.1 that 13 fixed income funds generate negative alphas in the single-factor regressions, but only 4 alphas are statistically significant. Table 6.1 shows that the results for the security selection tests are robust across the models. For each model employed, only 2 or 3 funds can earn abnormal profits by selecting undervalued securities. Hence, we conclude Turkish pension fund managers, in general, have failed to outperform the market over the analysis period.

Table 6.6: Numbers of positive and negative estimates for alphas and gammas across the models

This table reports the number of positive and negative estimates for alpha and gamma coefficients across single-factor, multi-factor and market timing models, given in equations (5.2), (5.3) and (5.7) respectively. The numbers of statistically significant estimates (at 5%) are given in parentheses.

	single-factor model		multi-factor model		market timing model			
	α		α		α		γ	
fund groups	**positive**	**negative**	**positive**	**negative**	**positive**	**negative**	**positive**	**negative**
money market	0(0)	12(12)	0(0)	12(12)	0(0)	12(12)	5(0)	7(4)
fixed income	1(1)	13(7)	1(1)	13(11)	2(0)	12(8)	4(0)	10(3)
flexible	3(1)	11(3)	5(0)	9(6)	6(1)	8(2)	5(1)	9(3)
balanced	0(0)	2(0)	0(0)	2(0)	2(0)	0(0)	0(0)	2(0)
equity	9(1)	2(0)	8(1)	3(1)	11(4)	0(0)	0(0)	11(6)
eurobond	0(0)	12(5)	2(0)	10(8)	1(0)	11(1)	6(1)	6(1)

6.3. Performance Persistence Results

Table 6.7 reports the average autocorrelation coefficients of the returns from the 1^{st} to 12^{th} lags. The joint insignificance of all autocorrelation coefficients is tested by Ljung-Box Q statistics. The critical value is 21.026 with 12 degrees of freedom at 5% significance level. It can be seen from Table 6.7 that, for all fund groups except money market funds, we fail to reject the null hypothesis of joint insignificance of all autocorrelations coefficients. However, for money market funds, the test statistic is highly significant. Hence, according to the results in Table 6.7, we conclude only money market funds have significant autocorrelations in the returns.

Table 6.7: Average autocorrelation coefficients and Ljung-Box Q statistics

This table reports the average autocorrelation coefficients from 1st to 12th order, across the fund groups. The joint insignificance of all autocorrelations is tested with the Ljung-Box Q statistics, calculated by:

$$Q = T(T+2)\sum_{k=1}^{12}\left(\frac{p(k)^2}{(T-k)}\right),$$

where T is the sample size and $p(k)$ is the autocorrelation at lag k. The resulting statistic is chi-square with 12 degrees of freedom. The critical value is 21.026 at 5%. A * indicates significance at 5%.

	lag1	lag2	lag3	lag4	lag5	lag6	lag7	lag8	lag9	lag10	lag11	lag12	Ljung-Box Q
money market	0.891	0.840	0.798	0.732	0.670	0.623	0.543	0.499	0.463	0.399	0.355	0.333	433.879*
fixed income	0.282	0.050	0.154	0.224	0.124	0.018	-0.007	-0.038	0.019	-0.037	-0.017	-0.075	16.484
flexible	0.147	0.071	0.153	0.096	0.125	-0.045	0.019	0.010	0.114	-0.133	-0.013	0.106	11.268
balanced	0.065	-0.022	0.064	0.091	0.149	-0.239	-0.025	0.000	0.050	-0.198	-0.090	0.114	15.348
equity	0.075	0.032	0.151	0.038	0.076	-0.172	-0.028	-0.017	0.119	-0.218	-0.096	0.131	15.041
eurobond	0.122	0.006	0.004	-0.038	-0.088	-0.118	-0.083	0.064	0.083	0.014	-0.035	0.022	5.412

Our second test on returns is the Winner-Loser test. This test aims to measure the persistence in medium-term. Table 6.8 presents the two-way tables based on the categorization of funds as winner and loser funds as well as the LOR statistics and the results of the χ^2-test of independence. In some cases, the test based on LORs is not applicable. We see from Table 6.8 that, whenever the LOR test is applicable, both tests find evidence against persistence in performance. On the other hand, when the LOR test statistic cannot be calculated, the χ^2-test of independence rejects the null hypothesis of no performance persistence. However, the results based on only the χ^2-test of independence are not dependable as the test statistic has only 1 degree of freedom. For this reason, we check the robustness of these results by employing a cross-sectional regression-based approach.

Table 6.8: Two-way tables of returns over successive time periods

The sample period is divided into three sub-periods. The sub-periods are July, 2004 – December, 2006; December, 2006 – April, 2009; and April, 2009 – August, 2011. WW(LL) presents the number of funds that are winners(losers) in two successive sub-periods and WL(LW) presents the number of funds that are winner(loser) in the first period and loser(winner) in the subsequent period. The χ^2 statistic is the test statistic of the traditional χ^2-test of independence. The critical value with 1 degree of freedom is 3.84 at 5%. LOR is the log-odds-ratio calculated by $LOR = ln\left(\frac{WW.LL}{WL.LW}\right)$. A * indicates significance at 5% level.

	subsequent time periods	WW	LL	WL	LW	χ^2	p-value	LOR	p-value
money market	2004/2006 - 2006/2009	3	3	1	1	2.00	0.157	1.346	0.178
	2006/2009 - 2009/2011	4	4	0	0	8.00*	0.005	NA	NA
fixed income	2004/2006 - 2006/2009	4	3	0	0	7.00*	0.008	NA	NA
	2006/2009 - 2009/2011	4	3	0	0	7.00*	0.008	NA	NA
balanced & flexible	2004/2006 - 2006/2009	3	2	2	2	0.09	0.764	0.299	0.765
	2006/2009 - 2009/2011	3	2	2	2	0.09	0.764	0.299	0.765
equity	2004/2006 - 2006/2009	3	3	0	0	6.00*	0.014	NA	NA
	2006/2009 - 2009/2011	1	1	2	2	0.67	0.414	-1.386	0.423
eurobond	2004/2006 - 2006/2009	2	1	1	1	0.14	0.709	0.371	0.711
	2006/2009 - 2009/2011	2	1	1	1	0.14	0.709	0.371	0.711

In the cross sectional regression, we regress returns in a sub-period on the returns from the preceding sub-period in order to examine to what extent returns on the latter explains the returns on the former. We estimate the equation (5.13) by OLS and use robust standard errors. The results are presented in Table 6.9. The coefficient a_1 is significant for only money market funds. For the other fund groups, a_1 is insignificant which means the returns are not persistent in medium-term.

Table 6.9: Results for the cross-sectional persistence tests

The sample period is divided into three sub-periods. The sub-periods are July, 2004 – December, 2006; December, 2006 – April, 2009; and April, 2009 – August, 2011. The medium term persistence is tested by estimating the cross-sectional model given in equation (5.13):

$$r_2 = a_0 + a_1 r_1 + \varepsilon$$

where r_2 and r_1 are returns in the latter and former sub-periods, respectively. In the estimation process, OLS procedure with Newey-West corrected standard errors are used. A positive and statistically significant a_1 coefficient is consistent with persistence in returns. This table reports the estimated coefficients and the associated p-values as well as adjusted-R^2 values. A * indicates significance at 5%.

	subsequent time periods	**a_0**	**p-value**	**a_1**	**p-value**	**adj.-R^2**
money market	2004/2006 - 2006/2009	0.26*	0.00	0.44*	0.00	0.72
	2006/2009 - 2009/2011	-0.16*	0.00	0.71*	0.00	0.92
fixed income	2004/2006 - 2006/2009	0.23	0.11	0.53	0.07	0.38
	2006/2009 - 2009/2011	0.13	0.46	0.15	0.68	-0.06
balanced & flexible	2004/2006 - 2006/2009	0.31	0.19	0.09	0.80	-0.12
	2006/2009 - 2009/2011	0.31*	0.00	-0.16	0.24	0.00
equity	2004/2006 - 2006/2009	-0.64	0.07	0.57	0.11	0.44
	2006/2009 - 2009/2011	0.77*	0.00	0.26	0.64	-0.13
eurobond	2004/2006 - 2006/2009	0.26*	0.00	-0.08	0.67	-0.14
	2006/2009 - 2009/2011	0.13	0.31	0.61	0.30	-0.13

Overall, we conclude that Turkish pension funds, in general, do not show evidence of medium-term persistence in performance. However, the money market funds are an exception. In both Winner-Loser test and the cross-sectional regression analysis, we reject the null hypothesis of no performance persistence for this group. Moreover, the results are consistent with the autocorrelation structures of the returns.

We also test for short-term persistence in performance. For this reason, we set up equally weighted portfolios of top-performing funds and worst-performing funds which are rebalanced monthly. If the performance is persistent in the short-term, we expect the rebalanced portfolios of top-performers will realize positive abnormal returns and the portfolios of worst performers will perform poorly during the analysis period. In order to see if the performance persists in the short-term, we estimate our multi-factor model, given in equation (5.3), using Newey-West corrected standard errors to account for potential heteroskedasticity and serial autocorrelation in the errors. The results are presented in Table 6.10. We see from this table that, alphas are significantly different from zero for all fund groups and for all portfolios. Specifically, for fixed income, balanced & flexible, equity and eurobond fund groups, the best performing portfolios yield significantly positive alphas and the worst-performing funds produce significantly negative alphas. However, in the money market fund group, both portfolios generate significantly negative alphas. This is expected because in single-benchmark, multi-factor and market timing models, each money market fund yields a significantly negative alpha meaning that even the best performing portfolio in this group comprises poor performers. Hence, we conclude Turkish pension funds display persistence in short-term performance. However, it must be noted that this persistence cannot be exploited to generate abnormal returns in the long-term because it is only a short-term phenomenon.

Table 6.10: Results of the time-series regressions for short-term persistence

The performances of best-performing and worst-performing portfolios are evaluated by estimating the multi-factor model given in equation (5.3):

$$r_{it} - r_{ft} = \alpha_i + \beta_{i1}(r_{m1,t} - r_{ft}) + \beta_{i2}(r_{m2,t} - r_{ft}) + \cdots + \beta_{in}(r_{mn,t} - r_{ft}) + \varepsilon_{it}$$

This model is estimated by OLS procedure using Newey-West corrected standard errors. The portfolio structures and investment strategies are different between fund groups. Hence, we use specific sets of benchmarks across the fund groups. This table reports the estimates for α and β coefficients as well as the associated p-values. α represents the value added by security selection and β's are interpreted as the sensitivities to different market proxies. A * indicates significance at 5% level.

money market	**α**	**p-value**	**β_KYD O/N Gross Repo Index (TL)**	**p-value**	**β_KYD Bond Index 91 Days (TL)**	**p-value**	**β_KYD Gen. Bond Index (TL)**	**p-value**
best-performing	-0.10%*	0.00	0.50*	0.00	0.12*	0.02	0.01	0.17
worst-performing	-0.30%*	0.00	0.30	0.06	-0.23*	0.00	0.02*	0.02

fixed income	**α**	**p-value**	**β_KYD Gen. Bond Index (TL)**	**p-value**	**β_KYD Bond Index 91 Days (TL)**	**p-value**	**β_KYD O/N Gross Repo Index (TL)**	**p-value**	**β_ISE National 100**	**p-value**
best-performing	0.28%*	0.00	0.66*	0.00	0.64*	0.02	0.00	0.42	1.53*	0.01
worst-performing	-0.65%*	0.00	0.63*	0.00	1.03*	0.00	0.02*	0.01	-0.65	0.44

balanced & flexible	**α**	**p-value**	**β_KYD Gen. Bond Index (TL)**	**p-value**	**β_ISE National 100**	**p-value**	**β_KYD O/N Gross Repo Index (TL)**	**p-value**	**β_KYD Bond Index 91 Days (TL)**	**p-value**
best-performing	2.25%*	0.00	-0.14	0.57	0.54	0.40	0.16*	0.00	-1.02	0.56
worst-performing	-2.44%*	0.00	0.16	0.63	1.77*	0.04	0.22*	0.00	-0.63	0.65

equity	**α**	**p-value**	**β_ISE National 100**	**p-value**	**β_KYD Gen. Bond Index (TL)**	**p-value**	**β_KYD O/N Gross Repo Index (TL)**	**p-value**
best-performing	1.62%*	0.00	0.86*	0.00	0.24	0.15	-1.26	0.42
worst-performing	-1.22%*	0.00	0.86*	0.00	0.05	0.85	-3.49*	0.01

eurobond	**α**	**p-value**	**β_KYD Eurobond Index (USD-TL)**	**p-value**	**β_KYD Eurobond Index (EUR-TL)**	**p-value**	**β_ISE National 100**	**p-value**
best-performing	1.42%*	0.00	0.67*	0.00	0.22*	0.00	-0.50*	0.00
worst-performing	-1.87*	0.00	0.26*	0.02	0.35*	0.00	-0.09	0.65

7. Conclusions

In this study, we analyze a sample of 65 pension funds operating in the Individual Pension System in Turkey, over the period July, 2004 – August, 2011. We investigate the performances of the funds in terms of security selection and market timing abilities of fund managers. We also measure the persistence in performance. In order to test for security selection skills of the managers, single- and multi-factor models are employed. Then, we estimate an option-based model to separate market timing skills from security selection. Lastly, we implement parametric and non-parametric tests to measure persistence in pension fund performances.

Before measuring the performances at the individual fund level, we estimate alphas for value weighted portfolios. Neither the value weighted portfolio of 65 funds nor any of the portfolios for the fund groups generated significantly positive alpha estimates. The results from single- and multi-factor analyses indicate that pension fund managers, in general, have not been able to outperform the market by selecting undervalued securities. According to our findings from the single-factor model, only 3 funds have generated positive abnormal returns. The number of outperforming funds drops to 2 when we switch to the multi-factor model. For both models, the majority of the funds have either underperformed the market or shown insignificant selectivity. The results are consistent with the US evidence on mutual fund performance.

In order to measure timing abilities of pension fund managers, following Weigel (1991), we employ an extension of Henriksson and Merton’s (1981) model. In total, only 2 funds have shown evidence of market timing, while 17 funds have displayed perverse market timing. The remaining 46 funds have failed to provide any evidence of macro-forecasting.

Over the analysis period, money market funds have been the most unsuccessful fund group in terms of security selection skills displayed by the managers. All funds in this group have generated significantly negative selectivity estimates in single- and multi-factor models. On the other hand, equity funds have been relatively more successful than other groups. The results from the single- and multi-factor analyses indicate that the ratio of positive (not necessarily significant) security selection estimates is the highest for equity funds among other groups.

The results from the Winner-Loser test and the cross sectional regression indicate that only money market funds show evidence of persistence in medium-term performance. However, this persistence cannot be exploited by the investors to earn abnormal profits because all funds in this group have underperformed during the analysis period. In other words, money market funds have shown medium-term persistence in poor performance. Moreover, we document that investing in a monthly rebalanced portfolio of the most recent top performing funds yields positive abnormal returns over the analysis period. We also show that monthly rebalanced portfolios comprising only the worst-performing funds of the previous month realize negative abnormal returns. Hence, we conclude pension fund performances are persistent in the short-term.

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Appendix

Table A.1: The codes and names of the funds in the sample

code	name
AE1	Avivasa Emeklilik ve Hayat A.Ş. Gov't Bonds and Bills Liquid PMF
AE2	Avivasa Emeklilik ve Hayat A.Ş. Gov't Bonds and Bills Income PMF
AE3	Avivasa Emeklilik ve Hayat A.Ş. Flexible Growth PMF
AE6	Avivasa Emeklilik ve Hayat A.Ş. Gov't Bonds and Bills (USD) Income PMF
AE7	Avivasa Emeklilik ve Hayat A.Ş. Gov't Bonds and Bills (EURO) Income PMF
AEB	Avivasa Emeklilik ve Hayat A.Ş. Stock Growth Group PMF
AEG	Avivasa Emeklilik ve Hayat A.Ş. Flexible Income PMF
AEH	Avivasa Emeklilik ve Hayat A.Ş. Stock PMF
AEK	Avivasa Emeklilik ve Hayat A.Ş. Gov't Bonds and Bills Group PMF
AH0	Anadolu Hayat Emeklilik A.Ş. Flexible Growth PMF
AH1	Anadolu Hayat Emeklilik A.Ş. Gov't Bonds and Bills Income PMF
AH2	Anadolu Hayat Emeklilik A.Ş. Gov't Bonds and Bills Liquid PMF
AH3	Anadolu Hayat Emeklilik A.Ş. Composite Bonds and Bills Income (USD) PMF
AH4	Anadolu Hayat Emeklilik A.Ş. Composite Bonds and Bills Income (Euro) PMF
AH5	Anadolu Hayat Emeklilik A.Ş. Stoch Growth PMF
AH8	Anadolu Hayat Emeklilik A.Ş. Flexible Income PMF
AH9	Anadolu Hayat Emeklilik A.Ş. Flexible PMF
AHB	Anadolu Hayat Emeklilik A.Ş. Stock Growth White PMF
ANE	Aegon Emeklilik ve Hayat A.Ş. Balanced PMF
ANG	Aegon Emeklilik ve Hayat A.Ş. Gov't Bonds and Bills Income PMF
ANK	Aegon Emeklilik ve Hayat A.Ş. Gov't Bonds and Bills Liquid PMF
ANS	Aegon Emeklilik ve Hayat A.Ş. Stock Income PMF
ATE	Anadolu Hayat Emeklilik A.Ş. Flexible Growth Orange PMF
ATK	Anadolu Hayat Emeklilik A.Ş. Gov't Bonds and Bills Income Orange PMF
AVD	Avivasa Emeklilik ve Hayat A.Ş. Balanced PMF
AVE	Avivasa Emeklilik ve Hayat A.Ş. Flexible PMF
AVG	Avivasa Emeklilik ve Hayat A.Ş. Gov't Bonds and Bills (FX) Income PMF
AVH	Avivasa Emeklilik ve Hayat A.Ş. Stock Growth PMF
AVK	Avivasa Emeklilik ve Hayat A.Ş. Gov't Bonds and Bills PMF
AVL	Avivasa Emeklilik ve Hayat A.Ş. Gov't Bonds and Bills Liquid PMF
BED	Groupama Emeklilik A.Ş. Gov't Bonds and Bills (FX) Income PMF
BEE	Groupama Emeklilik A.Ş. Flexible PMF
BEH	Groupama Emeklilik A.Ş. Stock Growth PMF
BEK	Groupama Emeklilik A.Ş. Gov't Bonds and Bills Income PMF

Table A.1: The codes and names of the funds in the sample (continued)

code	name
BEL	Groupama Emeklilik A.Ş. Liquid- Government PMF
FEB	Fortis Emeklilik ve Hayat A.Ş. Gov't Bonds and Bills (FX) Income PMF
FED	Fortis Emeklilik ve Hayat (FX) Income PMF
FEE	Fortis Emeklilik ve Hayat Flexible PMF
FEK	Fortis Emeklilik ve Hayat A.Ş. Gov't Bonds and Bills Income PMF
FEL	Fortis Emeklilik ve Hayat A.Ş. Liquid-Gov't PMF
FEP	Fortis Emeklilik ve Hayat A.Ş. Trust Liquid-Gov't PMF
FHE	Finans Emeklilik ve Hayat A.Ş. Flexible PMF
FHH	Finans Emeklilik ve Hayat A.Ş. Stock Growth PMF
FHK	Finans Emeklilik ve Hayat A.Ş. Gov't Bonds and Bills Income PMF
FHL	Finans Emeklilik ve Hayat A.Ş. Gov't Bonds and Bills Liquid PMF
GED	Garanti Emeklilik ve Hayat A.Ş. Flexible Growth PMF
GEH	Garanti Emeklilik ve Hayat A.Ş. Stock Growth PMF
GEK	Garanti Emeklilik ve Hayat A.Ş. Gov't Bonds and Bills Income PMF
GEL	Garanti Emeklilik ve Hayat A.Ş. Liquid-Gov't PMF
GHE	Garanti Emeklilik ve Hayat A.Ş. Flexible PMF
GHG	Garanti Emeklilik ve Hayat A.Ş. Gov't Bonds and Bills (Eurobond) PMF
GKB	Garanti Emeklilik ve Hayat A.Ş. Gov't Bonds and Bills PMF
HS1	Anadolu Hayat Emeklilik A.Ş. Gov't Bonds and Bills Income White PMF
VEE	Vakıf Emeklilik A.Ş. Flexible PMF
VEH	Vakıf Emeklilik A.Ş. Stock Growth PMF
VEK	Vakıf Emeklilik A.Ş. Gov't Bonds and Bills Income PMF
VEL	Vakıf Emeklilik A.Ş. Gov't Bonds and Bills Liquid PMF
VET	Vakıf Emeklilik A.Ş. Gov't Eurobond Income PMF
YEE	Yapı Kredi Emeklilik A.Ş. Flexible PMF
YEH	Yapı Kredi Emeklilik A.Ş. Stock Growth PMF
YEK	Yapı Kredi Emeklilik A.Ş. Gov't Bonds and Bills Income PMF
YEL	Yapı Kredi Emeklilik A.Ş. Composite Bonds and Bills Trust Liquid PMF
YEP	Yapı Kredi Emeklilik A.Ş. Gov't Bonds and Bills Liquid PMF
YGE	Yapı Kredi Emeklilik A.Ş. Gov't Bonds and Bills (Euro) Income PMF
YKK	Yapı Kredi Emeklilik A.Ş. Gov't Bonds and Bills (Eurobond) Income PMF

Table A.2: Augmented Dickey Fuller Test Statistics and Critical Values at 1%, 5% and 10%

We employ the Augmented Dickey-Fuller (ADF) test with 12 lags to see if the excess returns of the funds and benchmarks are stationary. The test statistic is calculated from the following regression:

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \sum_{j=1}^{12} \beta_j \Delta Y_{t-j} + \varepsilon_t$$

In the model, Y is the time series to be tested and ε_t is the error term. In this test, the null hypothesis H_0: $\alpha_1 = 0$ is tested against the alternative H_1: $\alpha_1 < 0$. If we reject the null, we confirm stationarity.

code/benchmark	ADF Test Statistics	Critical Values		
		1%	5%	10%
AE1	-7.64	-3.531	-2.902	-2.586
AE2	-7.448	-3.53	-2.901	-2.586
AE3	-8.295	-3.53	-2.901	-2.586
AE4	-7.804	-3.53	-2.901	-2.586
AE6	-7.258	-3.539	-2.907	-2.588
AE7	-7.709	-3.539	-2.907	-2.588
AEB	-8.141	-3.539	-2.907	-2.588
AEG	-44.315	-3.539	-2.907	-2.588
AEH	-6.717	-3.574	-2.927	-2.598
AEK	-19.904	-3.539	-2.907	-2.588
AH0	-8.69	-3.53	-2.901	-2.586
AH1	-16.336	-3.53	-2.901	-2.586
AH2	-14.973	-3.53	-2.901	-2.586
AH3	-7.242	-3.53	-2.901	-2.586
AH4	-7.843	-3.53	-2.901	-2.586
AH5	-8.759	-3.53	-2.901	-2.586
AH6	-9.619	-3.53	-2.901	-2.586
AH8	-21.695	-3.53	-2.901	-2.586
AH9	-8.834	-3.53	-2.901	-2.586
AHB	-6.753	-3.569	-2.924	-2.597
ANE	-9.491	-3.53	-2.901	-2.586
ANG	-8.109	-3.53	-2.901	-2.586
ANK	-8.748	-3.53	-2.901	-2.586
ANS	-7.85	-3.53	-2.901	-2.586
ANU	-8.046	-3.53	-2.901	-2.586
ATE	-8.191	-3.558	-2.917	-2.594
ATK	-7.54	-3.558	-2.917	-2.594
AVD	-8.171	-3.535	-2.904	-2.587
AVE	-8.415	-3.535	-2.904	-2.587
AVG	-8.263	-3.535	-2.904	-2.587
AVH	-6.631	-3.572	-2.925	-2.598
AVK	-17.521	-3.535	-2.904	-2.587
AVL	-15.249	-3.535	-2.904	-2.587
AVU	-7.062	-3.535	-2.904	-2.587
BED	-8.097	-3.53	-2.901	-2.586
BEE	-8.268	-3.53	-2.901	-2.586
BEH	-8.232	-3.53	-2.901	-2.586
BEK	-17.367	-3.53	-2.901	-2.586

Table A.2: Augmented Dickey Fuller Test Statistics and Critical Values at 1%, 5% and 10% (continued)

code/benchmark	ADF Test Statistics	Critical Values		
		1%	5%	10%
BEL	-9.689	-3.53	-2.901	-2.586
FEB	-5.809	-3.587	-2.933	-2.601
FED	-6.073	-3.587	-2.933	-2.601
FEE	-7.611	-3.555	-2.916	-2.593
FEK	-7.456	-3.555	-2.916	-2.593
FEL	-13.148	-3.555	-2.916	-2.593
FEP	-7.437	-3.555	-2.916	-2.593
FHE	-5.99	-3.668	-2.966	-2.616
FHH	-4.408	-3.668	-2.966	-2.616
FHK	-26.116	-3.668	-2.966	-2.616
FHL	-11.109	-3.668	-2.966	-2.616
FHU	-2.929	-3.668	-2.966	-2.616
GED	-7.345	-3.535	-2.904	-2.587
GEH	-8.515	-3.53	-2.901	-2.586
GEK	-15.477	-3.53	-2.901	-2.586
GEL	-15.556	-3.53	-2.901	-2.586
GEU	-7.568	-3.53	-2.901	-2.586
GHE	-8.598	-3.53	-2.901	-2.586
GHG	-8.075	-3.53	-2.901	-2.586
GKB	-7.695	-3.552	-2.914	-2.592
HS1	-6.734	-3.545	-2.91	-2.59
VEE	-6.919	-3.53	-2.901	-2.586
VEG	-8.703	-3.53	-2.901	-2.586
VEH	-7.939	-3.53	-2.901	-2.586
VEK	-20.274	-3.53	-2.901	-2.586
VEL	-7.312	-3.53	-2.901	-2.586
VET	-7.722	-3.53	-2.901	-2.586
VEU	-8.091	-3.53	-2.901	-2.586
YEE	-8.523	-3.53	-2.901	-2.586
YEH	-8.263	-3.53	-2.901	-2.586
YEK	-16.367	-3.53	-2.901	-2.586
YEL	-9.775	-3.53	-2.901	-2.586
YEP	-8.475	-3.53	-2.901	-2.586
YEU	-8.513	-3.53	-2.901	-2.586
YGE	-5.978	-3.566	-2.922	-2.596
YKK	-7.364	-3.573	-2.926	-2.598
KYD General Bond Index (TL)	-8.403	-3.531	-2.902	-2.586
KYD O/N Gross Repo Index (TL)	-4.746	-3.531	-2.902	-2.586
KYD Eurobond Index (USD-TL)	-7.651	-3.531	-2.902	-2.586
KYD Eurobond Index (EUR-TL)	-8.064	-3.531	-2.902	-2.586
ISE National 100	-8.502	-3.531	-2.902	-2.586
KYD Bond Index 91 Days (TL)	-7.667	-3.531	-2.902	-2.586

Table A.3: Adj-$R^{2'}$s and p-values for the tests of assumptions in the single-factor model

We use Breusch-Pagan test to see if homoskedasticity assumption is fulfilled. In this test, the squared residuals from the fitted model are regressed on the regressors from the original model. In order to check if no-serial-autocorrelation assumption holds, we employ Bresch-Godfrey test which takes residuals from the regression model, and regresses them on the original explanatory variables as well as lagged residuals. Both tests produce a χ^2-test statistic. If the associated p-value is below the significance level, we reject the null hypothesis of homoskedasticity or no-serial-autocorrelation in the errors. The normality assumption is tested with a Skewness/Kurtosis test. This table reports the p-values for the tests as well as the adjusted-R^2 values for the single-factor model given in equation (5.2).

code	Test for homoskedasticity Breusch-Pagan (p-value)	Test for serial autocorrelation Breusch-Godfrey (p-value)	Skewness/Kurtosis Test for Normality (p-value)	Adj-R^2
AE1	0	0.0339	0	0.0201
AE2	0.1778	0.3569	0.0021	0.8108
AE3	0.5381	0.143	0.4252	0.8731
AE6	0	0.3324	0	0.4131
AE7	0.0026	0.9592	0.1855	0.7543
AEB	0.9564	0.0047	0.9077	0.9283
AEG	0	0.3593	0.0043	0.2944
AEH	0.9628	0.0107	0.9694	0.9187
AEK	0	0.4854	0	0.8472
AH0	0.449	0.4526	0.0047	0.6892
AH1	0.8303	0.651	0.0031	0.78
AH2	0	0.0051	0	0.0417
AH3	0.0115	0.6425	0.1052	0.6852
AH4	0.0246	0.7421	0.3798	0.8046
AH5	0.1138	0.0514	0.5835	0.9018
AH8	0	0.0002	0	0.1868
AH9	0.609	0.6454	0.0255	0.8389
AHB	0.2293	0.0106	0.7139	0.8936
ANE	0.0798	0.0449	0.0421	0.8069
ANG	0	0.9011	0.0001	0.6832
ANK	0.1658	0.0272	0.0115	0.0094
ANS	0.0097	0.0004	0.2042	0.8996
ATE	0.0138	0.1838	0.2365	0.8964
ATK	0	0.6781	0	0.8569
AVD	0.0476	0.6815	0.2012	0.7699
AVE	0.0173	0.4701	0.0131	0.6883
AVG	0	0.0132	0	0.7427
AVH	0.8735	0.0152	0.8898	0.9259
AVK	0	0.8541	0	0.8005
AVL	0.0024	0.0057	0.0253	0.0036
BED	0	0.526	0.0002	0.5713
BEE	0.0002	0.2293	0.0213	0.6542
BEH	0.004	0.0083	0.0543	0.8761
BEK	0.1139	0.2757	0.0796	0.6454
BEL	0.0057	0.052	0.0072	0.002
FEB	0.001	0.239	0.0085	0.5924
FED	0	0.2331	0	0.6034

Table A.3: Adj-R^{2}'s and p-values for the tests of assumptions in the single-factor model (continued)

code	Test for homoskedasticity Breusch-Pagan (p-value)	Test for serial autocorrelation Breusch-Godfrey (p-value)	Skewness/Kurtosis Test for Normality (p-value)	Adj-R²
FEE	0.097	0.6965	0.0318	0.756
FEK	0	0.7774	0	0.6791
FEL	0.1292	0.0031	0.0948	0.1253
FEP	0	0.0032	0.0033	0.0084
FHE	0	0.288	0.0028	0.3946
FHH	0.1952	0.0989	0.5368	0.887
FHK	0.5914	0.5407	0.6058	0.2049
FHL	0	0.0496	0.0094	-0.0278
GED	0.1367	0.8378	0.0431	0.4281
GEH	0.0015	0	0.0582	0.901
GEK	0	0.0906	0	0.8173
GEL	0.001	0.0016	0.0567	0.0954
GHE	0.2503	0.061	0.0907	0.8419
GHG	0	0.3701	0.0002	0.6507
GKB	0.9904	0.6115	0.711	0.6316
HS1	0	0.0994	0.0007	0.634
VEE	0	0.9803	0.0004	0.6629
VEH	0.0001	0.0025	0.0372	0.8761
VEK	0	0.8294	0	0.6281
VEL	0.8276	0	0.3248	-0.0119
VET	0.037	0.3048	0.0007	0.6509
YEE	0.0046	0.1721	0	0.6741
YEH	0.3363	0.001	0.7094	0.9136
YEK	0.3187	0.3331	0.041	0.8572
YEL	0	0	0.0174	0.0507
YEP	0	0.0014	0.0003	0.1682
YGE	0	0.6162	0	0.6744
YKK	0.0389	0.3265	0.0074	0.6452

value weighted portfolios	Test for homoskedasticity Breusch-Pagan (p-value)	Test for serial autocorrelation Breusch-Godfrey (p-value)	Skewness/Kurtosis Test for Normality (p-value)	Adj-R²
money market	0	0.0009	0.0175	0.0574
fixed income	0.4408	0.1715	0.0119	0.8319
flexible	0.0047	0.2289	0.0132	0.8586
balanced	0.7364	0.7045	0.3694	0.8259
equity	0.1379	0.0002	0.6342	0.9199
eurobond	0.0001	0.0701	0.0012	0.8287

Table A.4: Adj-R^{2}'s and p-values for the tests of assumptions in the multi-factor model

We use Breusch-Pagan test to see if homoskedasticity assumption is fulfilled. In this test, the squared residuals from the fitted model are regressed on the regressors from the original model. In order to check if no-serial-autocorrelation assumption holds, we employ Bresch-Godfrey test which takes residuals from the regression model, and regresses them on the original explanatory variables as well as lagged residuals. Both tests produce a χ^2-test statistic. If the associated p-value is below the significance level, we reject the null hypothesis of homoskedasticity or no-serial-autocorrelation in the errors. The normality assumption is tested with a Skewness/Kurtosis test. This table reports the p-values for the tests as well as the adjusted-R^2 values for the multi-factor model given in equation (5.3).

code	Test for homoskedasticity Breusch-Pagan (p-value)	Test for serial autocorrelation Breusch-Godfrey (p-value)	Skewness/Kurtosis Test for Normality (p-value)	Adj-R^2
AE1	0.0006	0.1164	0.0022	0.4501
AE2	0.1778	0.4373	0.0048	0.849
AE3	0.5469	0.2505	0.9311	0.8978
AE6	0	0.8602	0.0007	0.7745
AE7	0.1444	0.2774	0.0139	0.8659
AEB	0.6684	0.0026	0.7615	0.9283
AEG	0.0003	0.8373	0.0021	0.6501
AEH	0.6947	0.0029	0.8623	0.9176
AEK	0	0.2318	0.0019	0.8522
AH0	0.0099	0.7539	0.0274	0.7371
AH1	0.1378	0.4083	0.0163	0.8108
AH2	0.0014	0.0081	0.0033	0.3431
AH3	0.0001	0.0093	0.0001	0.8534
AH4	0.0655	0.0172	0.0971	0.9133
AH5	0.1483	0.0286	0.6163	0.9009
AH8	0.001	0.3699	0.0087	0.7627
AH9	0.2976	0.8521	0.213	0.8521
AHB	0.2191	0.0066	0.674	0.8939
ANE	0.2444	0.0223	0.0404	0.8057
ANG	0	0.2525	0	0.7237
ANK	0	0.006	0	0.3014
ANS	0.0066	0.0003	0.1726	0.8991
ATE	0.8873	0.0002	0.4873	0.9197
ATK	0	0.6375	0	0.878
AVD	0.0027	0.686	0.0404	0.772
AVE	0.0796	0.4958	0.0869	0.6989
AVG	0	0.1262	0.0002	0.8107
AVH	0.3953	0.0104	0.7841	0.9239
AVK	0	0.8356	0	0.7953
AVL	0.0338	0.0009	0.0273	0.0726
BED	0.106	0.9725	0.594	0.7683
BEE	0.1757	0.1564	0.3848	0.7061
BEH	0.0017	0.004	0.0284	0.8789
BEK	0.0011	0.0428	0.0148	0.6705
BEL	0.0601	0.0039	0.0251	-0.0044
FEB	0.0291	0.3534	0.2672	0.8244
FED	0.0728	0.522	0.3015	0.8401

Table A.4: Adj-R^{2}'s and p-values for the tests of assumptions in the multi-factor model (continued)

code	Test for homoskedasticity Breusch-Pagan (p-value)	Test for serial autocorrelation Breusch-Godfrey (p-value)	Skewness/Kurtosis Test for Normality (p-value)	Adj-R^2
FEE	0.9578	0.2848	0.5674	0.7963
FEK	0	0.7569	0	0.6703
FEL	0.0127	0.092	0.2808	0.6468
FEP	0	0.0721	0	0.7211
FHE	0.0034	0.4615	0.0232	0.418
FHH	0.2102	0.0287	0.6456	0.8834
FHK	0.1725	0.3051	0.5716	0.1928
FHL	0.0494	0.0883	0.4073	0.3806
GED	0.6483	0.8692	0.0183	0.4908
GEH	0.0025	0	0.0591	0.8991
GEK	0.001	0.0537	0.0037	0.8494
GEL	0.0013	0.0001	0.1389	0.26
GHE	0.018	0.0061	0.0261	0.854
GHG	0	0.0516	0.0002	0.8297
GKB	0.8453	0.4769	0.553	0.6653
HS1	0.0001	0.0973	0.0067	0.6449
VEE	0	0.334	0.0013	0.6837
VEH	0.0001	0.0023	0.031	0.8754
VEK	0	0.1733	0	0.6423
VEL	0	0	0.018	0.0563
VET	0	0.809	0.0004	0.8206
YEE	0.0132	0.1577	0	0.6707
YEH	0.3325	0.0012	0.5755	0.9141
YEK	0.1339	0.1598	0.0695	0.8707
YEL	0.0011	0	0.0867	0.3221
YEP	0.0743	0.0001	0.0829	0.4189
YGE	0.4417	0.2382	0.1793	0.8745
YKK	0	0.0754	0.0024	0.7502

value weighted portfolios	Test for homoskedasticity Breusch-Pagan (p-value)	Test for serial autocorrelation Breusch-Godfrey (p-value)	Skewness/Kurtosis Test for Normality (p-value)	Adj-R^2
money market	0.0006	0	0.0745	0.2943
fixed income	0.2381	0.0599	0.043	0.8595
flexible	0.6729	0.1138	0.1499	0.8718
balanced	0.1973	0.751	0.1269	0.8265
equity	0.1967	0.0001	0.6502	0.9198
eurobond	0.1707	0.029	0.0208	0.8521

Table A.5: Adj-$R^{2'}$s and p-values for the tests of assumptions in the market timing model

We use Breusch-Pagan test to see if homoskedasticity assumption is fulfilled. In this test, the squared residuals from the fitted model are regressed on the regressors from the original model. In order to check if no-serial-autocorrelation assumption holds, we employ Bresch-Godfrey test which takes residuals from the regression model, and regresses them on the original explanatory variables as well as lagged residuals. Both tests produce a χ^2-test statistic. If the associated p-value is below the significance level, we reject the null hypothesis of homoskedasticity or no-serial-autocorrelation in the errors. The normality assumption is tested with a Skewness/Kurtosis test. This table reports the p-values for the tests as well as the adjusted-R^2 values for the market timing model given in equation (5.7).

code	Test for homoskedasticity Breusch-Pagan (p-value)	Test for serial autocorrelation Breusch-Godfrey (p-value)	Skewness/Kurtosis Test for Normality (p-value)	Adj-R^2
AE1	0.0005	0.1048	0.002	0.4434
AE2	0.0695	0.3813	0.0034	0.8479
AE3	0.4078	0.2406	0.86	0.897
AE6	0	0.8611	0.0005	0.7724
AE7	0.122	0.2237	0.0129	0.8644
AEB	0.5259	0.0088	0.6621	0.9299
AEG	0.0026	0.8442	0.0032	0.6466
AEH	0.5928	0.0059	0.8019	0.9169
AEK	0.0003	0.1196	0.0076	0.8534
AH0	0.0001	0.6906	0.0062	0.7352
AH1	0.5175	0.3776	0.0215	0.8098
AH2	0.0014	0.0081	0.0034	0.335
AH3	0	0.0188	0	0.8538
AH4	0.0925	0.0035	0.1022	0.9144
AH5	0.1097	0.0519	0.605	0.9005
AH8	0.0015	0.3872	0.0103	0.7605
AH9	0.2986	0.8378	0.2133	0.8503
AHB	0.0973	0.0105	0.5541	0.8924
ANE	0.2475	0.0641	0.0356	0.8059
ANG	0	0.3154	0	0.724
ANK	0	0.0062	0	0.2968
ANS	0.0004	0.0014	0.0894	0.9043
ATE	0.5097	0.0031	0.155	0.9319
ATK	0	0.3994	0	0.8805
AVD	0.0001	0.7059	0.0133	0.7706
AVE	0.0034	0.5744	0.0304	0.6982
AVG	0.0003	0.1796	0.0009	0.8103
AVH	0.2091	0.0195	0.6566	0.9243
AVK	0	0.8575	0	0.7962
AVL	0.2318	0.0002	0.0486	0.126
BED	0.0747	0.9553	0.5441	0.7663
BEE	0.1232	0.1485	0.3544	0.7026
BEH	0.5963	0.012	0.3493	0.8858
BEK	0.0139	0.0426	0.0307	0.6677
BEL	0.0863	0.0034	0.0408	-0.0092
FEB	0.0258	0.3284	0.2209	0.8212
FED	0.0672	0.5428	0.2739	0.8381

Table A.5: Adj-R^2's and p-values for the tests of assumptions in the market timing model (continued)

code	Test for homoskedasticity Breusch-Pagan (p-value)	Test for serial autocorrelation Breusch-Godfrey (p-value)	Skewness/Kurtosis Test for Normality (p-value)	Adj-R^2
FEE	0.0493	0.5306	0.467	0.8225
FEK	0	0.7403	0	0.6736
FEL	0.1316	0.1773	0.2996	0.7101
FEP	0	0.1153	0.0001	0.7437
FHE	0.0783	0.4063	0.0895	0.5026
FHH	0.2183	0.0305	0.5893	0.88
FHK	0.3286	0.3072	0.6173	0.1819
FHL	0.5758	0.1255	0.8414	0.461
GED	0.0015	0.6362	0.0043	0.5384
GEH	0.0014	0.0001	0.0533	0.901
GEK	0.0004	0.0486	0.0053	0.8507
GEL	0.0005	0.0001	0.108	0.252
GHE	0.0094	0.0195	0.0199	0.8559
GHG	0	0.136	0.0001	0.8318
GKB	0.4775	0.6706	0.6492	0.6736
HS1	0	0.093	0.0064	0.6398
VEE	0	0.6356	0.0111	0.687
VEH	0	0.0047	0.0268	0.876
VEK	0	0.1653	0	0.6406
VEL	0	0	0.0193	0.0669
VET	0	0.8713	0.0039	0.8267
YEE	0.0526	0.211	0	0.6696
YEH	0.0906	0.0043	0.4489	0.9154
YEK	0.3377	0.1615	0.1011	0.87
YEL	0.001	0	0.0851	0.3138
YEP	0.1351	0.0001	0.1093	0.4149
YGE	0.8544	0.2995	0.2862	0.8737
YKK	0.0014	0.1808	0.0143	0.7572

value weighted portfolios	Test for homoskedasticity Breusch-Pagan (p-value)	Test for serial autocorrelation Breusch-Godfrey (p-value)	Skewness/Kurtosis Test for Normality (p-value)	Adj-R^2
money market	0.0006	0	0.0747	0.2882
fixed income	0.6489	0.0532	0.0508	0.8587
flexible	0.6245	0.1318	0.1815	0.8716
balanced	0.0298	0.7201	0.0622	0.8265
equity	0.1161	0.0004	0.5854	0.921
eurobond	0.0629	0.0471	0.0199	0.8517