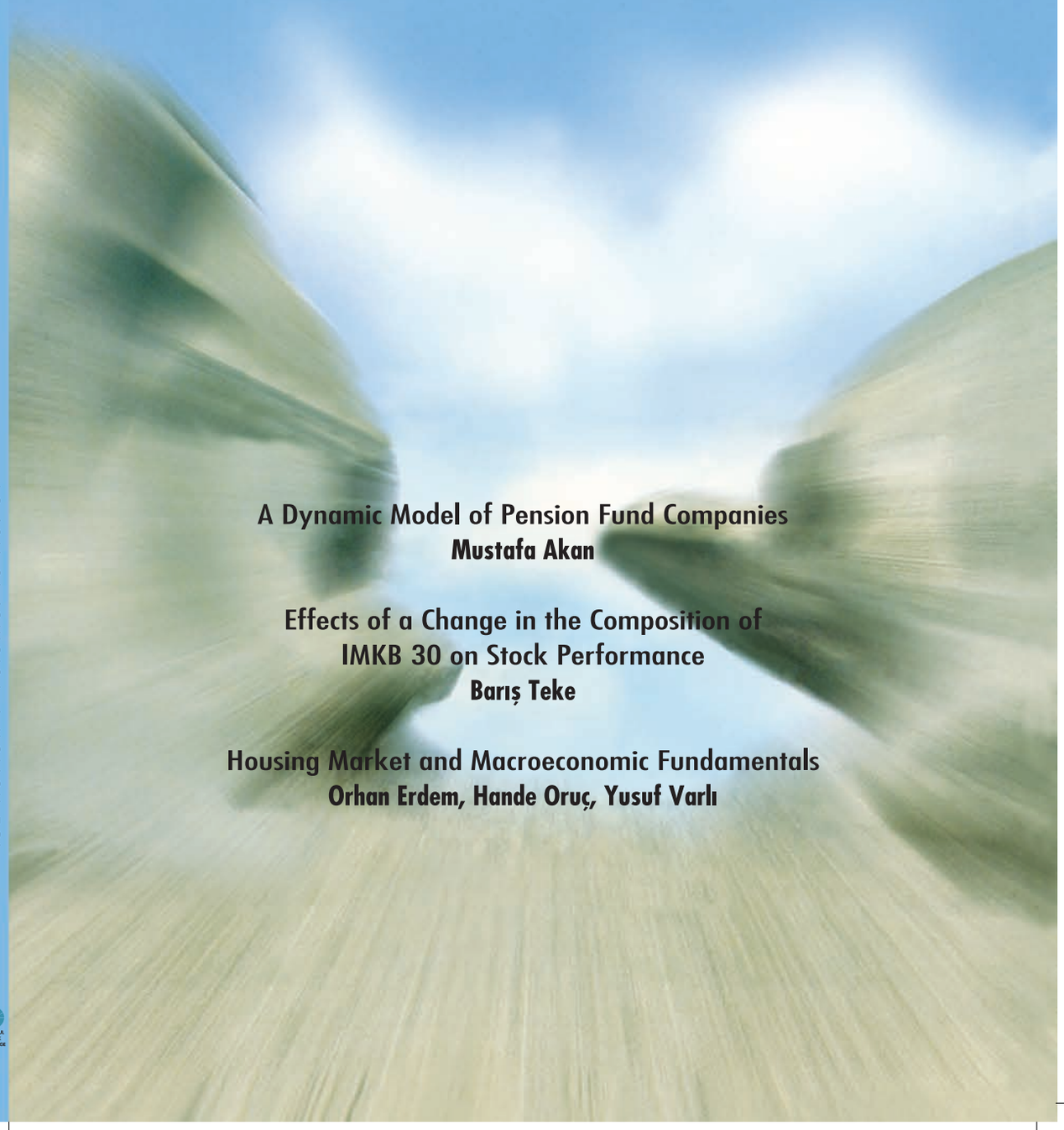
ISE REVIEW
Istanbul Stock Exchange

ISSN 1301-1642

Volume: 13 No: 51



ISE Review / Volume: 13 No: 51

The ISE Review

Quarterly Economics and Finance Review

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Editorial Production & Printing
UFUK REKLAMCILIK
Maltepe Mah. Gümüşsuyu
Cad. Çiftehavuzlar Yolu
1. Matb. Sitesi No:1/68
Topkapı / İSTANBUL
Tel: 0212 544 92 30
Fax: 0212 544 92 29
www.ufukmat.com
Print Date: April 2013

This review is published quarterly. Due to its legal status, the Istanbul Stock Exchange is exempt from corporate tax.
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Objectives and Contents

The ISE Review is a journal published quarterly by the Istanbul Stock Exchange (ISE). Theoretical and empirical articles examining primarily the capital markets and securities exchanges as well as economics, money, banking and other financial subjects constitute the scope of this journal.

Copy Guides for Authors

Articles sent to the ISE Review will be published after the examination of the Managing editor and the subsequent approval of the Editorial Board. Standard conditions that the articles should meet for publication are as follows:

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7. The main text should be arranged in sequentially numbered sections. The first section should be titled “Introduction”, while the last section should be titled “Conclusion” as the others should be titled and numbered with a second digit (2.1, 3.2 and so on). Using boldface is necessary to indicate headings.
8. References to personalities in the text should be entered as: Smith (1971) or (Smith, 1971); two authors: Smith and Mill (1965) or (Smith and Mill, 1965); three or more authors: Smith et al. (1974) or (Smith et al.,1974). References to papers by the same author(s) in the same year are distinguished by the letters a,b,c, etc. (e.g. Smith, 1974a). References should be listed at the end of the paper in alphabetical order.
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   - -Articles:
     [9]Harvey, Campbell R., “The World Price of Covariance Risk,” The Journal of Finance, Vol.XLVI, No.1, March 1991, pp. 11-157.
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The ISE Review Price and Payment Information:
Hard Copy: US$ 7.5 per copy (Issue No. 51)
Wire transfer to T. İş Bankası Borsa Branch
Account No: 1125 4599 (US$ account)
Please write the name of the publication and send us a copy of the receipt.

Address: İMKB (ISE) Research Department
Reşitpaşa Mah., Tuncay Artun Cad.
Emirgan 34467 Istanbul-TURKEY
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The ISE Review has been included in the "World Banking Abstracts" Index published by the Institute of European Finance (IEF) since 1997, in the Econlit (Jel on CD) Index published by the American Economic Association (AEA) since 2000, and in the TÜBİTAK-ULAKBİM Social Science Database since 2005.

The ISE Review Volume: 13 No: 51
ISSN 1301-1642 © İMKB 1997

A DYNAMIC MODEL OF PENSION FUND COMPANIES

Mustafa AKAN*

Abstract:
Two dynamic profit maximizing models of a pension fund company are developed and solved using calculus of variations techniques. Starting with a low portfolio management fee and increasing it gradually to a level of interest rate of Government paper is shown to be the optimal strategy which is contrary to the observed behavior of such companies. Thus, this result should lead the managers of such funds to review their pricing strategies.

Keywords: Pension Fund Companies, Dynamic Models, Portfolio Management Fee, Calculus of Variations
JEL Classitication: G20, G23

I. Intraduction

Social Security Institution (SSK), Bağkur, and Emekli Sandığı were all deficit financed health and pension systems for payrolled workers, small businessmen, and Government workers until they were merged into one organization, SGK (Sosyal Güvenlik Kurumu) in 2002.The total deficits (financed by the Treasury) for this Government run institutions were about 10,16,and 20 billion TL in the years of 2002, 2003,and 2004 respectively (Alceylan,2007). After the financial crisis in 2001, several measures were taken to remedy this problem as well as other measures in order to stabilize the financial sector. One of such measures was to allow the formation of private individual pension fund companies opening the way to voluntary individual investment in pension funds through Individual Retirement System (Bireysel Emeklik Sistemi, BES, in Turkish). The formation of companies started in year 2003. The number of such companies has now reached twelve with about 2.4 million customers and about 12.2 billion TL accumulated funds in 135 investment funds (BES Report and EGM).

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The main characteristics of the System (under the Individual Pension Savings and Investment Act of 2011) are:

- It is a voluntary system,
- Shareholders should have the necessary moral and financial strength and experience in financial sector,
- Any person over the age of 18 and able to exercise his or her's civil rights can join in the system,
- Participants have to stay in the System at least until the age of 56 and pay premiums for 10 years to benefit from tax advantages,
- The investment funds (at least three) have to be managed by portfolio management companies as opposed to the pension companies themselves,
- The Undersecretariat of Treasury, Capital Markets Board, and the Pension Monitoring Center are the relevant supervisory bodies for overseeing the functioning of the system.
- In order to be able to get established, the pension companies have to have a minimum of 10 million TL of capital, half of it which has to be paid at the formation of the company, the rest within three years after establishment.
- The pension company has to be equipped with necessary infrastructure to process the workload of 100,000 customers.

The System offers significant tax benefits for the participants such as:

- Contributions equal to 10% of the monthly salary is tax deductable with an upper limit of minimum wage if payments are made by the individuals themselves,
- Contributions equal to 10% of the monthly salary of the personnel participating in the System is tax deductable from the corporate tax base of the employer with the same maximum limit if the payments are made by the employer,
- The total tax deductable amount can not exceed 10% of the salary with a maximum limit of minimum wage regardless of who pays the contribution.
- These limits may be doubled by the Council of Ministers.
- No taxes are levied on these earnings.
- 25% of the funds are tax free; the rest is subject to tax rate of 5% if all funds are withdrawn from the System at the time of retirement.

- No tax will paid if funds are withdrawn on annuity basis.

Related to the fees that the pension fund companies can charge to customer, the following types and limits apply:

- **Entry Fee**- The maximum fee is the minimum monthly wage,
- **Management Fee**-The maximum rate is equal to 8% of **contributions,**
- **Portfolio Management Fee-**The maximum daily rate is 0.010% of the amount of accumulated funds. The portfolio management fee affects the performance of the pension fund most negatively due to its exponential impact on the accumulated funds.

There is not a large body of literature on this subject in Turkey since the System has only recently been introduced. However, Karaca (2000), Ergenekon (1998, 2001), Price-Waterhouse (2001, 2002), Gurleyen (2003), Teleri (2003), Babaoğlu (2004), Teker (2004), Teksöz (2011) are among the few who summarize the pension applications in the World and the Turkish System. Alp(2004),in her master's thesis, identified the parameters which affected the performance of a private pension fund company founded in Turkey, and ran a simulation analysis with these parameters to observe their impact on performance and concluded that, even with high fees charged by companies, the system yields sufficient benefits for the customers. Koç(2006),in another master's thesis, ran simulations on various system parameters and found that companies which make correct pricing decisions and control expenses can have significant long term profits. Similarly, Köksal (2006), a master's thesis, ran scenario analysis with different fees companies can charge, comparing the results with the scenario where the fees are set at their maximum levels.

Some books also cover the subject on a global perspective. Andersen (1985), Ippolito (1989), Outreville (1998), Blake (1995, 2001), Turner and Watanebe (1995) and Parmenter (1999) are some books on the subject of mathematics and economics of pensions. These studies include good amount of literature from around the world.

Stochastic approaches to pension fund management started in late eighties.Dufresne (1988) studied the variability of contribution rates and fund levels when rates of returns are random. Dufresne (1989) considered a funded pension plan where gains and losses are amortized over a fixed number of years to assess how contributions and the fund levels are affected when rates of returns are random. Haberman (1993) studied pension funding methods which determine contributions at each valuation by spreading the unfunded liability

over a fixed number of years. Real rates of return are assumed to be represented by a first order autoregressive process. Recursive formulae are obtained for the expectations and the variability of fund and contribution levels. Haberman and Vigna (2002) derived a formula for the optimal asset allocation in a defined contribution pension scheme in risky environment. Cairns and Parker (1997) studied the stochastic behavior of the funding level of a defined benefit pension plan through time and its relationship with the plan contribution rate under various assumptions. All of the studies above are about performance of funds under various conditions and not about the performance of pension companies.

Haberman and Sung (1994) presented a dynamic model of pension funding for a defined benefit occupational pension scheme. An objective function which involves simultaneous minimization of contribution rate risk and solvency risk are solved under various constraints. Boulier et al. (1995) modeled a pension fund to study the optimal asset allocation strategies and the control of future contribution flows using stochastic control. They showed that proportion of risky assets and the level of contribution are both proportional to the difference between maximum and the actual levels of wealth. Cairns (2000) considered the control strategies to optimize the contribution and the asset allocation strategies with n number of risky assets and a risk free asset and random benefit payments. Boulier et al. (2001) studied a defined benefit pension plan where a guarantee is given on the benefits which depend on the stochastic interest rates when the employee retires. They show that optimal composition of a fund must be divided among three parts, the present value of the contributions, a contingent claim delivering the guarantee, and a hedge fund. Blake, Cairns and Dowd (2001) estimate the value at risk in the accumulation stage of defined benefit pension plan. They examined a range of asset return models and asset allocation models. They found that defined contribution plans are more risky than defined benefit plans, value at risk is sensitive to the choice of asset allocation strategy, asset allocation strategy with high equity delivers higher return over the long term and bond based asset allocation strategies required higher contribution rates for the same benefit. Cairns, Blake, and Dowd (2000) developed an optimal asset allocation model for accumulation phase of a defined contribution pension plan in the presence of non-hedgable salary risk, and they found that it was optimal to invest in a combination of minimum risk portfolio relative to salary, a minimum risk portfolio compared to salary times the annuity at time t, and a high risk portfolio. Cairns, Blake, and Dowd (2003) showed that dynamic and stochastic asset allocation model is better than deterministic life-styling asset allocation

model which decreases the weight of equities and increases the weight of bonds gradually. Geyer and Ziemba (2008) developed a financial planning model for an Austrian pension fund. They used multi-period stochastic linear programming model for different time periods, using discrete probability scenarios for returns and other model parameters such as state dependent correlation among asset classes. Nwozo and Nkeki (2011) considered the optimal portfolio and strategic life-style consumption process of an individual in a defined contribution pension plan where there is a riskless asset and a risky asset, using dynamic programming techniques. They found that weight of risky assets should be decreased as time progresses to offset unforeseen shocks.

All these studies are about optimal stochastic dynamic investment strategies of pension funds. The author has not been able to identify any study, as of the writing of this paper, inside or outside of Turkey about the dynamic(deterministic) profit maximization model of a pension fund company itself. Therefore, it is thought that development of such a model can contribute to better strategic management of such firms in Turkey.

The purpose of this study is to build such a deterministic optimal control theoretic model to describe the optimal profit maximizing behavior of pension funds in the Turkish context. This may be a forerunner study in extending the coverage of pension fund literature to Turkey.

In the second section, which is the following, the methodology will be presented as a general model. In the third section a simple model will be solved. A more complex model will be analyzed in the fourth section. The results will be analyzed and suggestions for further studies will be offered in the last section.

II. Methodology

A pension company can be viewed as an intermediary which:

- Invests in the infrastructure and personnel to serve the customers. These cost items are assumed to be fixed over time.
- Advertises to customers to attract them, invests in education of the personnel and the quality of service to maintain the customers in the portfolio. These cost items are assumed to constant and consequently not taken into consideration in the optimization models.
- Collects the contributions from the customers. Each customer's contribution will be assumed to be a constant over time.

- Transfers the contributions (after it charges the relevant fee which is denoted as m (t) percent of the contributions) to the portfolio management company.
- Collects entry fee from the customers. This fee will be omitted from the analysis since it is small and does not have a strategic impact on the long term optimal behavior of the pension companies.
- Charges portfolio management fees denoted as p (t) as percentage of the accumulated funds denoted as $Q(t)$ .The portfolio performance is important in the sense that if the performance is poor, the customers can leave the company without impunity (after a year with the same company) taking away all of their accumulated funds to another company. However, in the models which will be developed in this paper, the performance of the funds will be a function of the management fee m (t) and the portfolio management fee p (t) rather than the performance of the fund managers. The reason for this assumption is the very high ratio of Government fixed income paper in the funds in existence (approximately %60) and the relative insignificance of effect of good fund management in such portfolios compared to the effects of levels of portfolio management fee and the management fees(EGM). Currently the portfolio management fees vary between 3.83 per 100000 per day and 8.87 per 100000 per day(EGM).The historical levels of these fees exhibited an inconsistent behavior(EGM).Some companies have started with high levels then decreased it, some doing the opposite ,and some still experimenting. **The general trend, however is that the rate is declining**. It is highly clear that the optimal strategy on this very important parameter is nonexistent.

Two models will be studied relating to the number of customers entering into the system (or a company) since the author knows of no study which describes the behavior of the customers in such cases.

Model I: The change in the number of customers $\dot{N}$ is proportional (α) to the difference between interest rate of government security(r) and the portfolio management fee (p (t)) i.e.

$$\dot{N} = \alpha(r - p(t)) \qquad (1)$$

The basic assumption for this model is that the management fee (m) is small compared to p (t), thus it is unimportant, i.e, m=0.

Model II: The change in the number of customers depend on how much money they have accumulated in the System as compared to how much they would have accumulated if they bought Government security themselves.i.e.

$$\dot{N} = \alpha(Q(t) - \int_0^{\tau} N(\tau)e^{at}\, d\tau) \qquad (2)$$

Where a is the return for the customer net of taxes, if he managed his money himself i.e. a=r*(1-β) where β is the effective income tax rate on the Government securities.

In the descriptions of the change in the number of customers of a company in the models above, it assumed that there is no limit in the number of customers that a company can have and no customer who already knows the company contacts another potential customer and tells him about the company (no word of mouth advertising).These cases, for a different topic, are addressed in another paper by Gould (1970).

The amount of funds accumulated at any time (t), $Q(t)$ obeys the differential equation:

$$\dot{Q}(t) = kN(t) + Q(t)(r - p(t)) \qquad (3)$$

Which explains that the accumulated funds increase by the contributions paid by existing customers and the net (after deduction of the portfolio management fee by the pension company) earnings of the existing portfolio. **We only consider the accumulation phase in this paper. Therefore the time horizon T is taken to be 10 years or more as defined by law.**

Consequently, the present value of the instantaneous rate of profit for a pension company at any time (t) is:

$$\Pi(t) = e^{-Rt} p(t)Q(t) \qquad (4)$$

The objective of the company is to maximize the total profits over the long term (fixed T) within the constraints defined by equation (1) or equation (2) and (3) by choosing p (t) optimally. This verbal objective can be written mathematically as:

$$\text{Maks.} \int_0^T \Pi(t).dt$$

$p(t) \geq 0$

Subject to Equations of $\dot{N}$ described above (one for each model) and (3) with the assumption that k=1 and;

$N(0)=0$
And $N(T)$ free (5)

$Q(0)=0$
And $Q(T)$ free (6)

Indicating that is the number of costumers and the amount of funds at the formation of the company are zero and each customer pays an amount of one TL continuously.

The models developed above will be solved in the following sections.

III. Solution of Model I (No Management fees, m=0 and no discount rate, R=0)

It as already been mentioned that the most important variable that affects the performance of the company is the portfolio management fee p(t) since it acts on the accumulated funds which increases at more than an exponential rate due to equation(3).

It is largely true that in a country like Turkey where the system is new and the only widely available investment alternative is the government securities. It can be assumed that the customers will eventually choose a company which can deliver the highest return for their funds. It will be assumed that the customers will enter into a company at a rate proportional to the earnings that the company can deliver. The earnings rate that a company can deliver can be defined as the

difference between the rate of the Government paper and the portfolio management fee that the company charges. Therefore the rate at which the total number of customers change can be written as:

$$\dot{N} = \alpha(r - p(t)) \tag{7}$$

Where r is the constant yield of the Government paper.

Equation (3) above can now be written as:

$$\dot{Q}(t) = kN(t) + Q(t)(r - p(t)) \tag{8}$$

The problem now is:

$$\text{Maximize.} \int_0^T \Pi(t).dt$$

$p(t) \geq 0$

Subject to constraints 5, 6, 7 and 8 where,

$\Pi(t)=p(t)Q(t)$ neglecting the present value factor for this simple model.

Taking the total time derivative of Equation (8) and using equation (7) results in;

$$Q'' = k\alpha(r - p(t)) + Q'(r - p(t)) - Qp' \tag{9}$$

Solving equation (9) for Q(t) and using it in (t) makes the problem a Calculus of Variations Problem where the Functional F is:

$$F = p.Q = p[k\alpha(r - p) + Q'(r - p) - Q'']/\ p'$$

Theory and examples of solutions of Calculus of Variations problems are considered in many classic books as (Gelfand and Famin, 1963, Hestenes, 1966 and Pontryagin, 1962).

The Functional is a function of p, p', Q', and Q''.The necessary conditions for this problem are:

$$F_{Q} - \frac{dF_{Q'}}{dt} + \frac{d^2 F_{Q''}}{dt^2} = 0 \qquad (10)$$

And,

$$F_{p} - \frac{dF_{p'}}{dt} = 0 \qquad (11)$$

Where;

$$F_{Q} = 0$$
$$F_{Q'} = p.(r - p(t)) / p'$$
$$F_{Q''} = -p / p'$$
$$F_{p} = ((r - 2p) + Q'(r - 2p)) / p'$$
$$F' = -p((r - p) + Q'(r - p) - Q'') / p'^2$$

The Legendre Condition is met since:

$$F_{Q'Q'} = 0$$

The transversality conditions are:

$$F_{Q'} = 0 = p(r - p) / p'$$
$$F_{p'} = 0$$
$$F_{Q'} = 0 = p(r - p) / p'$$
$$F_{p'} = 0$$

At t=T and t=0 since T and t=0 are fixed and Q and p (t) are free at end points.

Equation (10) can be written as:

$$-p.(r-p)/p^{'}-d(p/p^{'})/dt=C \tag{12}$$

Or,

$$-p(r-p)/p'+pp''/p'^{2}=c \tag{13}$$

Where c is an unknown constant.

The equation (13) , provided it can be solved or the time path of p(t) can adequately be described, will be sufficient for the solution of the optimization problem since p(t) is the only control variable. The number of customers in the portfolio N(t), can be described from equation (7) which, in turn, describes the total amount of funds, Q(t), accumulated in the system using equation (8). The necessary condition described in equation (11) is very complex differential equation (nonlinear second order) involving the variables p, p', p'', p''', Q', Q'', and Q'''. However, this equation does not need to be solved since equation (12) is sufficient to determine the optimal control variable.

Equation (13) can be written as a system of first order differential equations as:

$$\begin{aligned} p' &= x \\ -p(r-p)/x+px'/x^{2} &= c \end{aligned} \tag{14}$$

The system in (14) will be analyzed by phase plane analysis (Phase Diagram) to describe the optimal path for p in (x, p) space. This method is a widely used differential equation method details of which can be found in any differential equations book. The sign of the constant c is not known. The phase diagram will be constructed for both signs of the constant c.

Case I: c>0

The loci of points where p'=0 is p axis where x=0. p increases where x>o and p decreases where x<0.

The loci of points where x' is zero is all points where:

p(r-p)/x=-c or

x=-p(r-p)/c (15)

And all points where x=0 (16)

At all points above the curve defined by equation (15) and the p axis(x>0), x increases. Below this curve but above the p axis x decreases. x increases when x is below the curve defined by equation (15) and x is negative. Above the curve but below the p axis(x<0) x decreases (See similar phase diagrammatic analysis in Kamien and Schwartz, 1987and Gould,1970)

The phase plan efor the system in (x.p) is in figüre 1 below.

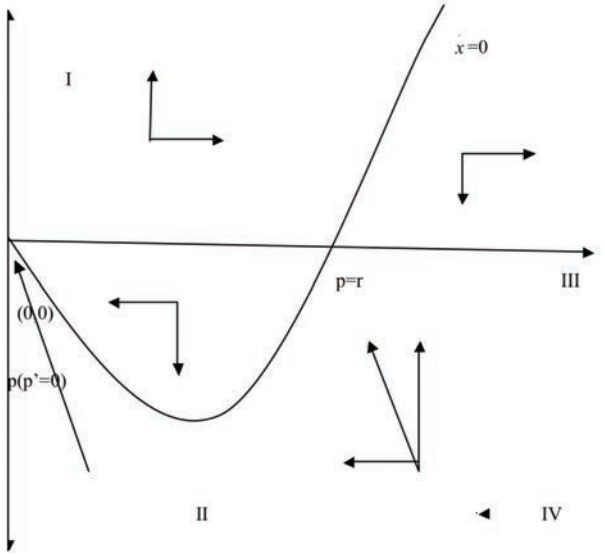

Figure 1: Phase Diagram for System in Equation (4) with c>o

The review of the phase diagram shows that the company should choose a large p (t), larger than r, at the beginning (Quadrant IV) and decrease it to an eventual level equal to r. However, it is clear that this solution is not optimal because of (3) and (7). **The only other equilibrium point appears to be (0,0) which implies that the optimal path should be such that the company should start with a large(smaller than r) and gradually decrease it to zero in the time duration of T if c>0** . Starting in the first or the third quadrants will not lead to equilibrium.

Case II:c<0

The loci of points where p'=0 is p axis where x=0. Points above the p axis where x>0 p is increases, whereas below where x<0, p decreases. The loci of points where x' is zero is all points where:

p(r-p)/x=c veya
x=p(r-p)/c (17)
and all points where;
x=0 (18)

At all points above the curve defined by equation (15) and the p axis(x>0), x decreases. Below this curve but above the p axis, x increases. x decreases when x is below the curve defined by equation (15) and x is negative. Above the curve but below the p axis(x<0) x increases.

The phase plane for the system in (x, p) is presented below.

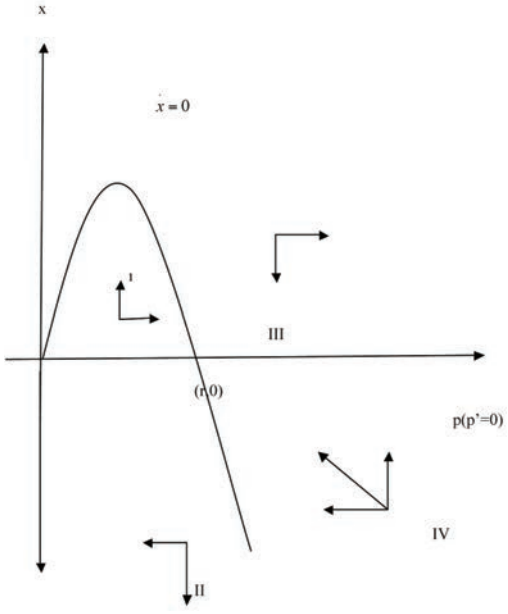

Figure 2: Phase Diagram for System in Equation (4) with c<o

The equilibrium point is (r,0) in (p,x) space. Starting in the third quadrant where p(0)>r will result in divergent solution. Starting in the first or the third quadrants with p (0) <r will lead to the equilibrium point (r,0).

This implies that the company will start charging a low rate of portfolio management fee but gradually increase it to r. Starting in the fourth quadrant will also lead to this point. However, this path is nonoptimal as explained previously. Starting in the third quadrant will result in a divergent solution.

IV. Solution of Model II-(No Management fee, m=0 and no discount rate, R=0)

The maximization problem in this case becomes:

$$\max \int_0^T p.Q.dt$$

p(t)≥0

Subject to:

$$\dot{Q} = N + Q(r - p(t))$$

$$\dot{N} = \alpha(Q - \int_0^t N(\tau)e^{a\tau}\, d\tau)$$

With Q(0)=0, N(0)=0, T fixed, Q(T) and N(T) free.

Taking the time derivative of N', substituting Q' into the resulting equation and solving for Q yields:

$$Q(t) = (N'' - N(1 - e^{at})) / (r - p)$$

Therefore the functional F=p.Q becomes:

$$F = pQ = p(N'' - N(1 - e^{at})) / (r - p) \qquad (19)$$

The Euler's Equation with respect to variable N is:

$$F_N - dF_{N'} / dt + d^2 F_{N''} / dt^2 = 0 =$$

$$-p(1-e^{at}) / (r-p) + d^2 (p / (r-p)) / dt^2 \quad \text{where,}$$

$$F_N = -p(1-e^{at}) / (r-p)$$

$$F_{N'} = 0$$

$$F_{N''} = p / (r-p)$$

If we let, for reasons of easier presentation, x=p/(r-p) then the Euler's equation becomes:

$$-x(1-e^{at}) + x'' = 0 \qquad (20)$$

Which is a linear second order variable coefficient differential equation?

The Euler's equation with respect to the variable p is:

$$N'' - N(1-e^{at}) = 0 \qquad (21)$$

Which is also a linear second order variable coefficient differential equation.

Both equation (20) and (21) are difficult differential equations to solve explicitly. Phase analysis methodology will be employed to characterize the solution. The analysis will be same both equations. Equation (20) can be written as a system of a system of first order differential equation as:

$$x' = y$$

$$y' = x(1-e^{at}) \qquad (22)$$

The phase diagram will be as follows:

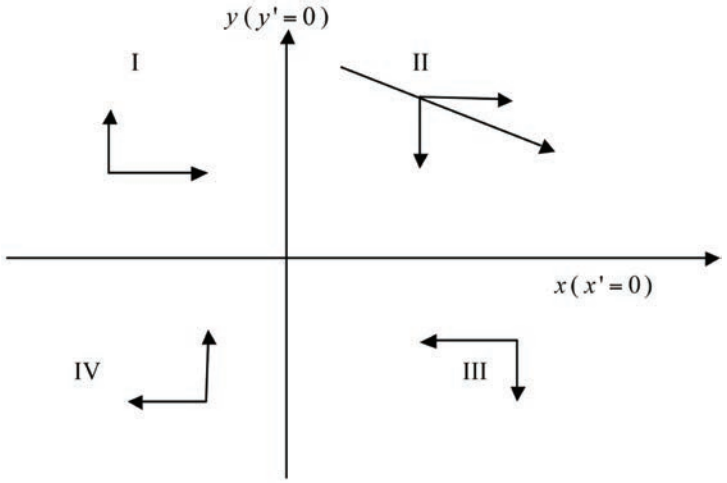

Figure 3: Phase Diagram for System in Equation (22)

At time t=0, y'=0 from the second equation in the system above. This along with p (t) ≥0 implies that the starting point is somewhere on axis with y>0(this is so because otherwise x' would be negative which would imply that p (t) becomes negative since x=p/(r-p), which is clearly not optimal). However, at t grows y' becomes negative since the term e^{at} becomes greater than 1.Therefore the quadrant II is where the optimal path exists. From the directional arrows in this quadrant, y declines while x increases.

However, since $x = p/(r-p)$, it is clear that $x' = p'r/(r-p)^2 > 0$.This implies that p'>0.**This, in turn, implies that it optimal for the firm to start with a low p and increase it gradually**.

V. Results and Suggestions for Further Research

The Euler's Equation (equation (12)) holds for all values of the constant c. However, the constant c is determined by the boundary conditions and the transversality conditions (equations (11.A)). It is evident in all solutions in models I that the optimal path for p (t) are such either p is starting at r and declining to zero, i.e, p'<0(if c>0), or, it is starting at zero and increasing to r(c<0) in the time duration of length T depending on the choice of the constant c. It is also evident that the objective function obtains a higher value for increasing

values of p (t) than for decreasing values (this was tested at length using difference equations and trying various time functions for p (t)).

This conclusion implies that the optimal(profit maximizing) strategy for pension fund managers will be to charge very low portfolio management fees in early years of the fund and increase it gradually as time progresses. The rate of increase should be high during early years and low in later years. This strategy will result in a rapid increase in the number of customers (who are paying a constant premium) building up the accumulated funds even though the portfolio management fee is lower. In later years, the fund will charge higher fees collected on higher accumulated funds thus contributing to the profitability of the fund.

We obtain a similar result for Model II.

The fact that the solution of models give the same result (that the portfolio management fee should be low at the beginning an increased as time progresses) imply that the optimal choice of this fee is more important than how the customers enter into the retirement system.

These results are contrary to thectual behavior exhibited by the pension fund companies in Turkey. This should lead the Management of pension fund companies to critically review their strategy in terms of portfolio management fees by taking into account the limitations and the simplicity of the models considered in this paper.

The models in this paper can be improved upon by relaxing the assumptions made on the management fees(m),constancy of discount rates r (return on Government securities),the amount of premiums(k=1),advertising expenses, and personnel expenses with the understanding that introduction of additional variables into dynamic models makes explicit solution of these models very difficult. Relaxation of the assumption about the time horizon ($T \geq 10$ years) makes this problem a very difficult problem also since customers may begin to leave the system after ten years This point is can be the subject of further studies on the topic.

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The ISE Review Volume: 13 No: 51
ISSN 1301-1642 © İMKB 1997

EFFECTS OF A CHANGE IN THE COMPOSITION OF İMKB 30 ON STOCK PERFORMANCE

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Abstract

A total of 60 incidents, of which 29 were additions to and 31 were exclusions from the index have been analyzed during the 23 index periods of İMKB 30 between the years 2005-2011. General conclusion is that announcements of change and the days of change do not have a significant impact on stock returns and transaction volumes during the period of analysis. It has been observed that additions to the index increase the transaction volume more than exclusions from it. It is believed that the investors predict the stocks that would be added to (excluded from) the index and adjust the prices accordingly before the change occurs. Besides, the effects of institutional investors that make transactions based on the index, including exchange traded funds, are limited. Effects of a change in index composition have been observed to be limited on the days of announcement and actual change and it is believed that the market has semi-strong form of efficiency. No proof could be identified on the validity of Price Pressure Hypothesis, Imperfect Substitutes Hypothesis or other hypotheses.

Keywords: İMKB 30 (ISE 30), market model, event study methodology, index composition, index changes, price and volume effects, efficient market hypothesis
JEL CLASSİTİCATİON: G00

I. Introduction

Initial studies analyzing the effects on stocks of additions to and exclusions from the index were carried out in mid 1980s in the US, particularly on S&P 500 Index. Researchers who did these early studies identified important changes in prices and transaction volumes and they proposed new hypotheses after

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concluding that the Efficient Markets Hypothesis is not valid. In consequent studies, however, these hypotheses were considered inadequate and new alternatives were added to the literature. In recent times, studies about changes in index compositions have been carried out on stock markets of countries other than the US and the validity of these hypotheses have been tested on the stocks in these markets. In light of these hypotheses, in this study, the changes in ISE 30, ISE's (Istanbul Stock Exchange) bluechip index, have been analyzed in the period 2005-2011 with the aim of understanding whether or not these changes have had an effect on the price and transaction volume performance of stocks.

II. Literature Review

2.1. Hypotheses Explaining Price and Volume Effects

There are a few hypotheses that explain price effects and abnormal returns based on changes in index composition. These hypotheses have been developed as a result of studies focusing especially on S&P 500 index in the US stock market. Some of these hypotheses claim that the event contains information while others claim it does not contain information. According to hypotheses containing information, expectations about firm's future cash flows affect the value of its stock.

Efficient Market Hypothesis asserts that financial markets are efficient from an information perspective. That is, all information available is already reflected in prices and any new information is instantly reflected, as well. This means that an investor cannot consistently achieve returns in excess of average market returns. First classical definition of this hypothesis was made by Fama (1970). According to this hypothesis, there are three market types: Weak form efficient market, semi-strong form efficient market and strong form efficient market. In weak form efficient market, prices already reflect all past publicly available information. In semi-strong form efficient market, prices reflect all past publicly available information and they quickly change to reflect new public information. In strong form efficient market, prices instantly reflect all information including even hidden or insider information. In Efficient Market Hypothesis, securities are assumed to be perfect substitutes[1]. As a result, demand curve is very elastic

1 Perfect subsitutes are similar goods that can replace each other when the need arise. When one's price decreases, demand for the other falls; when one's price increases, demand for the other rises (http://muhasebeturk.org).

and high volume buying or selling transactions do not have an impact on the price (Gregoriou & Ioannidis, 2006).

According to Price Pressure Hypothesis, due to a change in index composition, index fund transactions temporarily move the stock prices away from their equilibrium. The proof of this hypothesis is the fact that stock prices move back to their previous level after the change day. Excess demand or supply created by index funds would be absorbed by other investors and the change in price would be temporary.

According to Imperfect Substitutes Hypothesis, when a company is added to the index, a significant portion of the circulating stock would be bought by index funds. This increases the price by decreasing the available stock supply for other investors. In cases of exclusions from the index, the opposite occurs and increased supply decreases the price. If the long run demand curve were horizontal, decrease in stock supply would not affect the price. The hypothesis argues that stocks are not close substitutes, therefore the demand curve is downward sloping, which means it is not very elastic. Prices do not go back to their previous levels after the index has been changed.

Information Hypothesis relates the stock price movements to the information content of being added to (excluded from) the index. According to this hypothesis, index composition is determined by using information that is not available to public. This information contains firm's future income prospects.

Liquidity Hypothesis, asserts that adding a stock to the index increases the volume due to index fund transactions, thereby narrowing the bid-ask spread and thus increasing the price. This hypothesis was developed by Amihud and Mendelson in 1986.

2.2. Previous Studies

Studies that analyze whether or not additions to and exclusions from an index have an effect on a stock's return and transaction volume performance began on S&P 500 Index in the US and these studies constitute the base of the literature. Although most studies are focused on American markets, there have also been analyses, especially in recent times, on other countries' stock markets and their indices.

Initial studies, which conclude that announcement of inclusion to S&P 500 Index affects the stock price positively were carried out by Shleifer (1986) and Harris & Gurel (1986). These studies demonstrated that on the first day after the change, stock prices increase not because of the impact of new information on

expectations about future profitability of the company but rather due to increased demand of index funds, thereby presenting a conflict with the Efficient Market Hypothesis, which argues that all information available is already reflected in prices (Bildik & Gülay 2001). Shleifer (1986) found that stock prices went up by 2.79 % on average between 1976 and 1983. He argued the validity of the Imperfect Substitutes Hypothesis, which suggests that price increase is not continuous due to downward sloping long run demand for stocks. In their study covering years 1978-1983, Harris & Gurel (1986) found 3.13% abnormal return around the day of announcement. However, they also found that in the subsequent 29 days, abnormal return turned negative and became -2.39%. They could not reject the Price Pressure Hypothesis, which argues that abnormal return reverses after the event period. Carino & Pritamani (2007) examined the Russell 2000 Index and confirmed the validity of Price Pressure Hypothesis. Jain's (1987) research on S&P indices not closely followed by institutional investors like index funds provides evidence that abnormal return produced by inclusion to the index is a result of introduction of new information into the market. His findings did not support the Price Pressure Hypothesis and the Imperfect Substitutes Hypothesis, both of which claim that index announcement contains no information. Having identified price increases on corporate bonds of companies included in the S&P 500 on the day of announcement, Dhillon & Johnson (1991) argued that index announcement contains information. Furthermore, Denis, Mcconnell and Mayers (2002) observed an improved performance in companies included in the S&P 500 Index because of corporate governance and better management (Sun & Chen, 2007). Denis, McConnell, Ovtchinnikov & Yu (2003) concluded that inclusions in S&P 500 increase earnings per share and contain information. These provide evidence that inclusion to an index carries information content.

Even if it does not provide any new information about the future prospects of the company, a change in index composition effects demand because index funds following the index make adjustment in their portfolios by buying the stocks of companies that are newly added to the index and selling the stocks of those that have been removed from the index. Taking into account the reaction of institutional investors other than index funds, the change in demand might be even bigger. The fact that index funds adjust their portfolios on the day of actual change is used by arbitrageurs, who expect the price to go up because of the purchases of index funds, as an opportunity to purchase. Beneish & Whaley (1996) named this as the "S&P Game". The reason behind index funds' waiting

to adjust their portfolios till the change day is their effort to minimize tracking error. Beneish & Whaley have examined the changes in the composition of S&P 500 from January 1986 to June 1994. Until October 1989, S&P used to make its announcement on index changes on the day of change. However, after that date they changed the procedure and started to make the announcements 5 days before the day of change. Beneish & Whaley identified the emergence of S&P Game after that date. They found out that abnormal returns existed from the day of announcement till the day of change and that this abnormal return was higher than that realized under the previous announcement policy (Bildik & Gülay, 2001). Lynch and Mendenhall (1997) reached similar conclusions. According to them, even two weeks after the change day, there was 5% abnormal return. Moreover, even 60 days after the announcement, transaction volume was 30% higher, which they related to arbitrage activities carried out by derivative instruments. In their study analyzing the Dow Jones Industrial Average Index, Beneish & Whaley (1995) observed that newly included stocks were not affected from the change and they related this to the fact that there were no index funds following the DJIA Index. They did not accept the validity of Price Pressure Hypothesis and Imperfect Substitutes Hypothesis. Sui (2006), who did one of the most recent studies on the S&P 500 Index, calculated the average cumulative abnormal return as 8.44% for additions and -11.1% in exclusions, having observed abnormal returns even after the change day. He found evidence rejecting the downward sloping long run demand curve hypothesis, which had been supported by the majority of previous studies. According to him, demand curve is downward sloping in the short run but horizontal in the long run.

Another point of view regarding American stock markets is that of Chen, Noronha & Singal (2004). The conclusion of their study on S&P 500 Index was that there was a permanent increase in prices of added stock whereas there was a temporary decline in prices of excluded stocks. This finding contrasted with the previous explanations claiming that the price reaction would be symmetrical in cases of additions and exclusions. They argued that the asymmetrical price reaction was due to differences in investor awareness.

Most of the studies examining the effects of index changes on stock performance in markets other than those of the US have been carried out recently. When we look at the European Markets, we encounter the following studies: Bildik & Gülay (2001), who analyzed the ISE 30 and ISE 100 between 1995 and 2000, have observed that, being added to the index resulted in positive abnormal return and being excluded resulted in negative abnormal return from

the day of announcement till the day of change and that transaction volume increased significantly. However, since statistical significance of their findings were weak, they could not find evidence supporting Imperfect Substitutes Hypothesis or Price Pressure Hypothesis. They claimed that Liquidity Hypothesis explained the decreasing price and volume, which are the effects of being excluded from the index.

Barontini & Rigamonti (2000, quoted by Bildik & Gülay, 2001) found supporting evidence for Price Pressure Hypothesis in their research on Italian Mib 30 Index. Andelius & Skrutkowski (2008) could not find evidence for downward sloping demand curve phenomenon and did not observe abnormal volume in their research, which examined the OMXS 30 and other indices of the Swedish market between 1987 and 2006. Bechmann (2002, quoted by Andelius & Skrutkowski, 2008) analyzed KFX Index, the bluechip index of Denmark, and found 5% average abnormal return in additions. He emphasized that his findings supported Imperfect Substitutes Hypothesis and Information Hypothesis. Bankovica & Pranevics (2007); analysed the blue chip indices in Estonia, Lithuania, Latvia, Poland, Czech Republic, Slovenia, Hungary, Romania and Bulgaria. They observed 5.1% abnormal return in the month following the announcement and concluded that the event contains information. In his analysis of CAC 40, SBF 20 and FTSE 100 between 1997 and 2001, Vespro (2006) found evidence supporting Price Pressure Hypothesis regarding index fund adjustments. Besides, stressing the fact that the time between the announcement day and change day is longer in Europe than in US, he indicated that highest transaction volume is observed one day before the change day. Mase (2007) analyzed FTSE 100 in long run and short run from 1992 to 1999 and found abnormal return in both. Other researchers who analyzed FTSE such as Gregoriou & Ioannidis (2006) also reached conclusions consistent with Liquidity Hypothesis. Gregoriou (2011) also analyzed Cac 40 and concluded that transaction volume increased due to Liquidity Hypothesis.

One of the leading studies in Asia and Australia; Okada, Isagawa & Fujiwara (2004) analyzed the Nikkei Index between 1991 and 2002 and concluded that price movements were temporary because of arbitrageurs' demand. Prices that rose between the announcement day and change day declined after the change day. In his study on Nikkei 500 Index, Liu (2000) found evidence for Imperfect Substitutes Hypothesis. Hanaeda & Serita (2003, quoted by Okada, Isagawa & Fujiwara, 2004) argued that downward sloping demand curve exists in Japanese stock market. Shankar & Randhawa (2006)

identified changes in price and volume between 1998 and 2004 in Hong Kong's Hang Seng Index, however, they did not reach similar findings in Singapore's Strait Times Index. They considered this evidence that changes in price are caused by mismatch of supply and demand rather than by availability of new information. Sun & Chen (2007) analyzed the SH 30 and SZ 40 indices in China and could not find evidence for Price Pressure Hypothesis. Chuang, Liao & Yu (2009) did not encounter information effect in their study on Taiwanese market and confirmed the validity of Price Pressure Hypothesis. Regarding the changes in the Australian AOI Index, Chan & Howard (2002) observed significant changes in returns and volumes on and around the change day. Kumar (2005), who analyzed the changes in Nifty & Jr. Nifty indices in India, could not find significant change in price on announcement day but found 1.47% abnormal return only in Nifty Index on the change day, which reversed in 9 days. He did not observe a significant change in transaction volume.

III. ISE 30 Index

As of August 2011, ISE calculated 46 indices in order to monitor movements in the stock market[2]. Of these 46 indices, 6 are subject to periodical valuation. ISE 30, the blue chip index of ISE is one of the indices subject to periodical valuation.

ISE 30 is composed of, "30 stocks selected from among the companies traded in the National Market, the real estate investment trusts and the Venture Capital Investment Trusts traded in the Corporate Products Market" (ISE Circular no. 370). Besides, as is the case for all other ISE indices, stocks in list C[3] cannot be included in ISE 30. The index started to be calculated as of December 27, 1996 and its initial value was 976.

As is the case for all other ISE indices, ISE 30 is calculated based on weighted free float[4] market capitalization of stocks. Market capitalization of all

2 Only the number of price indices is mentioned. Price Indices are those that do not take into account distributed dividends in their calculation and maintenance. In this type of indices, only gains from the appreciation of the stock is taken into calculation of the index. (ISE Basic Information Guide, 2008).

3 A, B and C Lists: Lists that have been formed according to the criteria determined by the Capital Markets Board, containing stocks that are subject to different trading rules and sanctions (ISE Circular no. 370).

4 Free Float Rate: A concept defined by Capital Markets Board (CMB) to represent the portion of outstanding shares of a public company that is traded by general public. It is calculated and published by CRA (ISE Circular no. 370).

the companies in the index as of June 30, 2011 was 283.02 billion TL (free float market capitalization was 81 billion TL), which constituted 60.2% of the ISE stock market. There are various financial products that are based on ISE 30. There is one index fund[5] in ISE that is based on ISE 30. As of June 2011, it had a market capitalization of 8.31 million TL and a transaction volume of 190.91 million TL. As of June 2011, 22 warrants[6] based on ISE 30, which were issued by brokerage firms, were being traded. Moreover, as of June 2011 there are future contracts based on ISE 30 with a transaction volume of 31.64 billion TL in TURKDEX (Turkish Derivatives Exchange).

ISE 30 Index is reviewed four times a year on March, June, September and December. During these revisions, stocks that will be included in the next index period[7] are selected along with 2 reserve stocks. The valuation period[8] for the index is, the six month period preceding the last trade day for the transaction volume data and the last trade day of November, February, May and August for the market capitalization data. For the free float rate data, latest rates published by CRA (Central Registration Agency) during the periodic revision are taken into consideration (ISE Circular no. 370). Changes that will be made after the periodic revision of the index and the newly selected reserve stocks are announced at least 10 days before the concerned index period.

To be included in the index, the stocks need to be in lists A and B; stocks in list C cannot be included in any ISE index, including ISE 30. Only the stocks of companies traded in the National Market, the real estate investment trusts traded in the Corporate Products Market and the Venture Capital Investment Trusts can be included in ISE 30. Additionally, in order for them to be included, the stocks of these companies are required to have been traded for at least 60 days by the end of the valuation period. This requirement of having been traded for 60 days can be waived in the following case (ISE Circular no. 370):

If, as of the end of the initial public offering, the market capitalization of the publicly traded portion of the stock of a company or a bank is;

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5 The first and only index fund based on ISE 30 is "Finansbank A.Ş. İMKB 30 A Tipi Borsa Yatırım Fonu", which has been traded since 07.04.2009.

6 Warrants that are regulated by ISE Circular no. 318 dated January 5, 2010 have been traded in ISE since August 13, 2010.

7 The period in which changes made to the composition of ISE 30 Index during the last revision would be effective (ISE Circular no. 370).

8 The period in which data used for valuation during the last revision of the composition of ISE 30 was observed (ISE Circular no. 370).

- Larger than 1 billion TL or 1% of the free float market capitalization in the National Market and,
- Larger than the market capitalization of the company with the smallest free float market capitalization in the ISE 30 Index,

its stock shall be included in the Index as of its 5th day of trade, replacing the stock of the company with the smallest free float market capitalization in the ISE 30 Index.

IV. Methodology

4.1. Event Study Methodology

Performance of a stock in a certain period is assessed by event study methodology[9], to determine whether or not the event leads to abnormal return. A prediction period is used for predicting the performance in the event period. Event Studies are widely used for analyzing the market efficiency in various specific events, which affect stock prices, such as earnings announcements, mergers and acquisitions, share dilutions and additions to (exclusions from) indices. The benefit of event studies is that it provides a framework for assessing the speed at which prices are adjusted in response to information (Başoğlu et al., 2001; quoted by Kaderli & Demir, 2009). The objective of event study is to determine whether or not an abnormal return will take place around the date when an event is announced to the public (Kaderli & Demir, 2009).

An event study is carried out in three steps (De Jong, 2007):

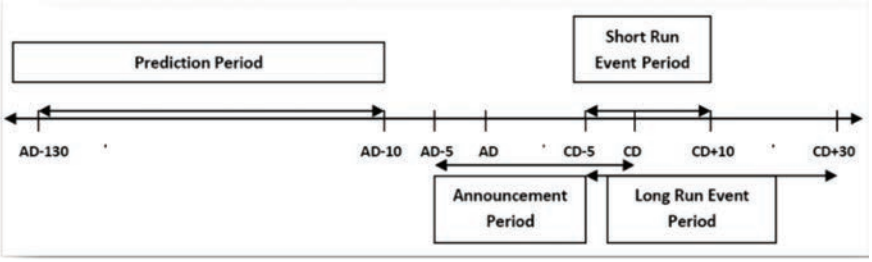
1. Defining the relevant event and in particular the timing of the event
2. Setting a benchmark model for comparison with normal stock return behavior
3. Calculating and analyzing the abnormal return around the event date

In an event study, normal return is estimated in order to calculate the abnormal return. There are two types of models that are used to calculate normal return: Statistical models like the Constant Mean Return Model and the Market Model and economic models such as the Capital Asset Pricing Model, the Arbitrage Pricing Model and the Fama Three Factor Model. According to the statistical models, return distribution is normal and independent. Significance of the output of these models is measured by t tests.

9 The first event study was published by Dolley in 1933. It was developed by Ball and Brown in 1968 and Fama and others followed suit in 1969.

In order to find the normal return some parameters need to be predicted. This prediction is done by the prediction period that precedes the event period. Prediction period and event period used in this study is presented in Figure 1.

Figure 1 : Prediction and Event Periods



4.2. Abnormal Returns

Abnormal return (AR) is defined as the difference between the realized return and the normal return. It cannot be explained by market movements and reflects the effect of the event. In this event study, Market Model[10] is used to calculate the normal return that needs to be predicted in order to determine the abnormal return. In the Market Model, abnormal return is predicted as follows (Campbell et al., 1997; quoted by Kaderli & Demir, 2009):

$$AR_{it} = R_{it} - ER_{it}$$

$$AR_{it} = R_{it} - \alpha_i - \beta_i \cdot R_{mt}$$

AR_{it} : abnormal return of stock i on day t

R_{it} : observed return of stock i on day t

ER_{it} : normal return of stock i on day t

R_{mt} **:** observed return of market on day t

10 Model is created in SPSS software by using simple linear regression. The software establishes the linear correlation by using the least squares method.

ISE 100 Index is used as benchmark to determine market return. Besides, adjusted closing price data for the stocks that are used in calculating the abnormal return and the closing price data of the index have been converted[11] to time series of returns.

In order to test the significance of predicted abnormal returns, first values are standardized with the method attributed to Patell (1976) and then they were compared with the values at 5% significance level on the t table. Standard deviation for stock i has been calculated as follows:

First, mean abnormal return (MAR) is calculated for stock i during period [T1,T2]:

$$MAR_i = \frac{1}{T-1} \sum_{t=T_1}^{T_2} AR_{it}$$

Standard deviation for stock i is predicted as follows:

$$s_i = \sqrt{\frac{1}{T_2 - T_1} \sum_{t=T_1}^{T_2} (AR_{it} - MAR_i)^2}$$

By using the predicted standard deviation, standardized abnormal return (SAR) is calculated as follows:

$$SAR_{it} = \frac{AR_{it}}{s_i}$$

Cumulative abnormal return (CAR) of stock i and its standardized value are calculated as follows based on the AR values by finding the mean cumulative abnormal return (MCAR) and the s values according to the formulas provided for AR:

11 $Return_{it} = \ln(price_{it}) - \ln(price_{it-1})$

$$CAR_{it} = \sum_{t=1}^{n} AR_{it}$$

$$SCAR_{it} = \frac{CAR_{it}}{s_i}$$

By using these formulas, CAR of each stock at the end of the event period has been calculated and their significance has been tested with standardized cumulative abnormal return (SCAR) values at 5% significance level on the t table. Besides, CAR values have been aggregated for the analysis period of 2005-2011. If the CAR_i value calculated for a stock is different from 0, it means that the announcement of the event affects the stock price thus making it possible to have an abnormal return on that stock (Kaderli & Demir). This means that the market is not efficient even in semi-strong form.

It is assumed that the return data in the study is independent and has a normal distribution. H_0 hypothesis to be tested under the hypothesis testing in the analysis is "announcements and the day of change regarding the addition (exclusion) of a stock into (from) the index has not affected the stock return". The alternative H_1 hypothesis is "announcements and the day of change regarding the addition (exclusion) of a stock into (from) the index has affected the stock return". If the calculated standardized abnormal return (SAR) and SCAR values are higher than the t table value, hypothesis H_0 will be rejected and statistical significance of AR and CAR will be acknowledged.

Furthermore, for the analysis period of 2005-2011, MAR has been calculated from the daily AR values during the event period and MCAR has been calculated from the CAR values of the stocks added (excluded) into (from) the index during the event period. This calculation has been done as follows:

$$MAR = \frac{1}{T}\sum_{i=1}^{T} AR_i$$

$$MCAR = \frac{1}{N}\sum_{i=1}^{N} CAR_i$$

Significance of the calculated MAR and MCAR values has been analyzed by subjecting them to one-sample t test at 5% significance level. T-statistic that is used to measure the significance of these values (averages of which have been analyzed) is calculated as follows:

$$t_{MAR} = \frac{\frac{1}{T}\sum_{t=1}^{T} AR_t}{\sqrt{\sigma^2_{ARt}/T}} \quad \text{ve} \quad t_{MCAR} = \frac{\frac{1}{N}\sum_{i=1}^{N} CAR_i}{\sqrt{\sigma^2_{CARi}/N}}$$

In this study, 3 event periods and 2 event days have been defined in the estimates made using the Market Model. Event periods are “announcement period”, “short run event period” and “long run event period”. Event days are “announcement day” (AD) and “change day” (CD). For the Announcement Period, the interval between AD-5 and CD-1; for the short run event period, the interval between CD-5 and CD+10; for the long run event period, the interval between CD-5 and CD+30 have been taken into consideration. In the model used in the study, analyses have been carried out by using 2 prediction periods, one being the actual and the other being the alternative. The first of these prediction periods is the actual prediction period (short prediction period) of 120 days, which spans from 10 days before the announcement day (AD-10) to 130 days before the announcement day (AD-130). This period corresponds to the 6 month performance period that is taken into consideration while making the calculations to determine the index composition. The second prediction period is the alternative prediction period (long prediction period) that is determined by taking into account the 1254 day performance (from Jan 2, 2006 to December 31, 2010) of the stocks that were added (excluded) into (from) the index. The reason why two prediction periods have been used in this study in contrast to other studies in the literature is that results obtained change relative to calculated parameters in the predicted period. In this way, performance of the stocks that were added (excluded) into (from) the index during the event periods can be

estimated according to the parameters calculated using both long and short run predictions. The objective of this approach is to have more accurate observations.

4.3. Transaction Volume

For the calculation of abnormal transaction volume, transaction volume ratio method of Harris & Gurel (1986) has been used.

$$VR_{it} = \frac{V_{it}/V_{mt}}{V_i/V_m}$$

V_{it}: transaction volume of stock i on day t in the event period

V_{mt}: transaction volume of market on day t in the event period

V_i : average transaction volume of stock i during the prediction period

V_m: average transaction volume of market during the prediction period

Volume data of ISE 100 index has been used as V_m and V_{mt} values in the calculation of volume ratio (VR).

For each stock included in the analysis, its average volume ratio (AVR) value has been calculated by taking the average of the daily VR values during the event period. Also, average AVR of each stock in each year and for the analysis period of 2005 to 2011 has been calculated. Mean volume ratio (MVR) for stock I has been calculated as follows:

$$MVR_i = \frac{1}{N} \sum_{t=1}^{N} VR_{it}$$

If VR equals 1; it means that there has been no abnormality during the event period. If VR is lower than 1, it means that transaction volume has decreased by that much during the event period. If VR is higher than 1, it means that transaction volume has increased by that much during the event period.

For the analysis period of 2005 to 2011, the calculation of daily MVR values from the daily VR values during the event period; the calculation of stock MVR values from the VR values of the stocks added (excluded) into (from) the index during the event period; and finally the calculation of general mean volume ratio (GMVR) from the stock MVR values have been made as follows:

$$MVR_t = \frac{1}{N}\sum_{i=1}^{N} VR_{it} \quad \text{ve} \quad MVR_i = \frac{1}{T}\sum_{t=1}^{T} VR_{it}$$

$$GMVR = \frac{1}{N}\sum_{i=1}^{N} MVR_i$$

Significance of daily and stock specific MVR and GMVR values has been tested by subjecting them to single-sample t test at 5 % significance level. T-test statistics used to measure the significance of these values (of which averages have been analyzed) is calculated as follows:

$$t_{MVRt} = \frac{\frac{1}{N}\sum_{i=1}^{N} VR_{it}}{\sqrt{\sigma^2_{VRit}/N}}, \quad t_{MVRi} = \frac{\frac{1}{T}\sum_{t=1}^{T} VR_{it}}{\sqrt{\sigma^2_{VRit}/T}},$$

$$t_{GMVR} = \frac{\frac{1}{N}\sum_{i=1}^{N} MVR_i}{\sqrt{\sigma^2_{MVRt}/N}}$$

V. Data

First, stocks added (excluded) into (from) the ISE 30 index during the analysis period have been determined[12]. In the 6-year period (2005-2011) there are 24 index periods and among these only one period (2008/1) did not have any

12 Source: ISE Directorate of Statistics

change in composition. In the 6 year period, 40 stocks were added into the index and 40 stocks were excluded from it. Of the 80 stocks that were subject to addition or
exclusion, 60 were analyzed. Of these 60, 29 were added into the index and 31 were excluded from it (See Table 6). The number of stocks that were excluded from the analysis and the reasons of their exclusion are as follows:

- 11 stocks fell into the 120-day prediction period (short prediction period) as they were added (excluded) into (from) the index in the preceding index period or the one before that. To ensure the reliability of the prediction period, these stocks were not included in the analysis.
- 7 stocks did not have data for the 120 days in the prediction period before the announcement day as they had only recently begun trading in the stock exchange.
- 1 stock
- β of 1 stock was calculated to be insignificant in the simple regression analysis that was done under the market model. Considering the complications it would cause in predicting the normal returns in the event period, this stock was excluded from the analysis.
- Data of 1 stock was inaccessible as it was no longer traded in the stock exchange.
- Besides, 3 additions (exclusions) into (from) the index were excluded from the analysis that was done according to the 5-year prediction period (long prediction period) as these stocks did not have 5 year data.

Aside from the stocks excluded from the study for various reasons explained above, of the 60 events of additions (exclusions) into (from) the index analyzed in the period from 2005 to 2011, 13 occurred in 2005, 6 occurred in 2006, 11 occurred in 2007, 9 occurred in 2008, 14 occurred in 2009 and 7 occurred in 2010.

In the study, for the short prediction period, adjusted price[13] and volume data[14] between 10 days before the announcement day (AD-10) and 130 days before the announcement day (AD-130); for the long prediction period, same data between 2006 and 2011 have been used. Furthermore, closing values[15] of

13 Adjusted prices are calculated in order to demonstrate the actual performance of the stocks in the event of stock splits.

14 Volume data were provided from Bloomberg.

15 Second session closing values of ISE 100 Price Index were used and were provided from ISE Web.

the ISE 100 Price Index and its volume data have been used to represent the market in the analyses.

VI. Empirical Findings

6.1. Abnormal Returns

According to the results of the study, between 2005 and 2011, although meaningful results exist on individual stock level, it has been observed that announcements about additions (exclusions) into (from) the index and the days of change have no statistically significant effect on stock returns. It can be inferred from Summary Table 1 that addition into the index has produced insignificant negative cumulative returns under both short and long prediction periods. The reason why the predicted values under the short prediction period are higher is that the period used for selecting the stocks to be added into the index coincides with the short prediction period and that the performance of stocks in this period tend to be higher compared to the analysis period when they go down to their normal levels. It has been observed that, due to the same reason, exclusion from the index produces positive return (though not statistically significant) under the short prediction period and that it produces negative abnormal return under the long prediction period. Another conclusion that can be inferred from the table is that effects of the movements observed in the announcement period and more intensely in short run event periods tend to reverse and that effect of small fluctuations in stock prices tend to be dispelled. Moreover, effects in short run event periods are larger, which indicates that the date of change affects the prices a little more than the announcement date.

SUMMARY TABLE 1	Short Prediction Period			Long Prediction Period		
ADDITION	MCAR	t statistics	st. deviation	MCAR	t statistics	st. deviation
Announcement Period	-3.71%	-1.647	0.12120	-1.18%	-0.634	0.0968
Short Run Event Period	-3.92%	-1.970	0.10722	-1.87%	-0.905	0.10734
Long Run Event Period	-2.91%	-0.742	0.21127	0.30%	0.012	0.13123
EXCLUSION						
Announcement Period	0.68%	0.343	0.1108	-1.81%	-1.046	0.0946
Short Run Event Period	-0.10%	-0.047	0.1164	-2.29%	-1.323	0.0948
Long Run Event Period	4.44%	1.294	0.1912	-0.30%	-0.113	0.1435

*MCAR values are not statistically significant.

Summary Table 2 indicates how many of the stocks that were added into the index during the analysis period, had a statistically significant increase or decrease in their cumulative abnormal returns. According to this, among the 29 stocks that were estimated under the short prediction period, number of those that increased is clearly higher than those that decreased whereas the distribution is more balanced under the long prediction period. As for the distribution of the stocks that were excluded from the index, while the situation is more balanced under the short prediction period, number of decreasing stocks is higher under the long prediction period.

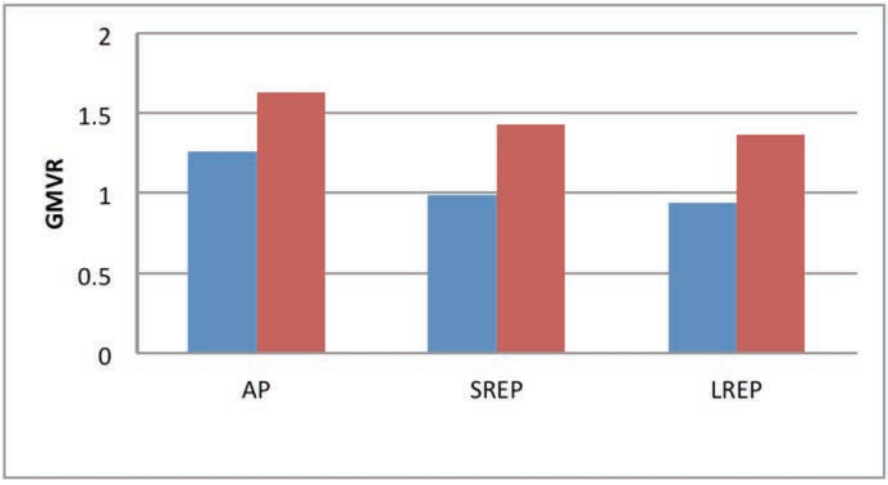
SUMMARY TABLE 2	Addition				Exclusion			
	Short Prediction Period (29)		Long Prediction Period (27)		Short Prediction Period (31)		Long Prediction Period (30)	
	Increase	Decrease	Increase	Decrease	Increase	Decrease	Increase	Decrease
Announcement Period	9	17	7	11	8	13	7	14
Short Run Event Period	2	13	6	7	10	11	6	14
Long Run Event Period	5	14	9	6	17	8	9	8

When the analysis is carried out on a daily basis, in case of addition of stocks into the index; although on the first working day after the announcement (AD+1) positive abnormal returns of 0.44% and 0.48% have been identified under the short prediction period and long prediction period, respectively; these figures are small and not statistically significant (See Table 1). Same holds true for the change day (CD): 0.37% and 0.41%. No significant abnormal return has been identified on other days. In case of exclusions of stocks from the index on the day AD+1, significant negative abnormal returns of -0.78% and -0.94% have been observed (See Table 2). On day CD, an insignificant negative abnormal return of -0.71% under the KTD and a significant negative abnormal return of -0.88% under the UTD have been observed. Both addition into and exclusion from the index caused significant negative abnormal return on day CD+8, however, when the situation is analyzed on individual stock level, number of stock with positive abnormal return and negative abnormal return are close to each other and it is not possible to consider this a peculiar case specific to this day.

6.2. Transaction Volume

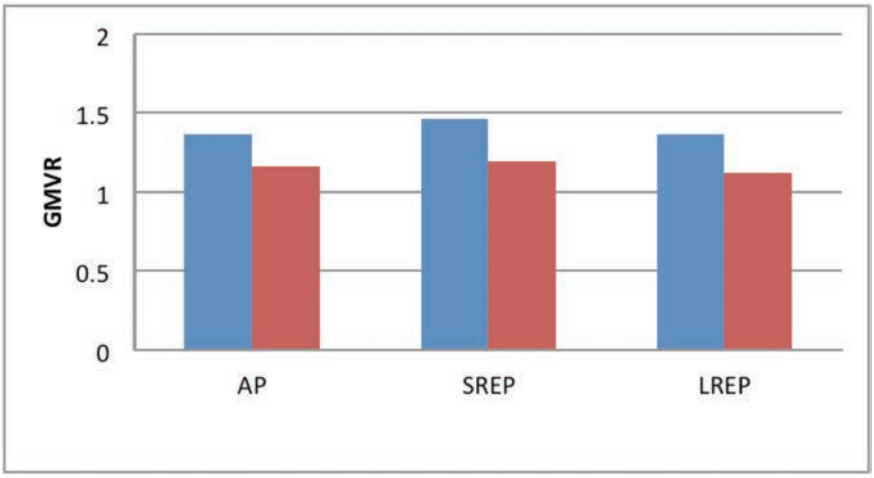
According to the results of the study, between 2005 and 2011, addition (exclusion) into (from) the ISE 30 Index had a statistically significant effect on stock transaction volume only under the long prediction period by causing an increase for the stocks added into the index. In other cases, although an increase was usually observed, no statistically significant results could be obtained. It can be seen from Graph 1 that addition into the index had an increasing effect on transaction volume, particularly in the announcement period. Transaction volume tended to go back to normal after the change date. Because stocks have a strong performance in terms of transaction volume under the short prediction period, they seem to have a weaker performance in event periods compared to the estimates under the long prediction period. If we consider the estimates under the short prediction period as benchmark, we can say that, though not statistically significant, there has been a 26.4% increase in the transaction volume in announcement event period. In short run event period and long run event period, transaction volume performance is close to the performance under the short prediction period: 98.37% and 93.84%. Under the long prediction period, statistically significant transaction volume increases of 62.92%, 43.2% and 36.59% have been identified.

Graph 1: General Mean Volume Ratios of Stocks Added into to the Index during the Event Periods between 2005 and 2011



Changes that occur in their transaction volume when stocks are excluded from the index is depicted in Graph 2. Although transaction volume increases in estimates made under both prediction periods, it has no statistical significance. The reason behind having higher results, particularly in estimates made under the short prediction period is that stocks perform weakly in terms of transaction volume during the index valuation period. Another noteworthy issue is that transaction volumes during the short run event period are a bit higher than other periods. The fact that average transaction volume ratios are higher than 1 even in estimates made under the long prediction period means that stocks have more transaction volume than normal in analysis periods.

Graph 2: General Mean Volume Ratios of Stocks Excluded from the Index during the Event Periods between 2005 and 2011



Summary Table 3 shows how much of the transaction volumes of the stocks was significantly increased and decreased by the change in index composition in the estimates made under both periods. According to the table, in the estimates made under the short prediction period, the number of stocks whose transaction volumes significantly decreased is higher than those whose transaction volumes increased. However, opposite is true for the estimates made under the long prediction period. This is also due to the stronger performance of stocks during the index valuation period. In case of exclusion from the index, it could be said that the number of stocks whose transaction volumes decreased equal the number of stocks whose transaction volumes increased, in the estimates made

under the short prediction period. On the other hand, the number of stocks whose transaction volumes decreased is higher, in the estimates made under the long prediction period. Considering this with the above analysis, exclusion from the index does not affect the transaction volume in the estimates made under the long prediction period.

SUMMARY TABLE 3	Addition				Exclusion			
	Short Prediction Period (29)		Long Prediction Period (27)		Short Prediction Period (31)		Long Prediction Period (30)	
	Increase	Decrease	Increase	Decrease	Increase	Decrease	Increase	Decrease
Announcement Period	8	12	15	7	8	10	4	13
Short Run Event Period	3	13	9	8	9	9	5	11
Long Run Event Period	7	15	10	6	7	9	8	11

When the change in transaction volume of stocks is analyzed on a daily basis (see Table 1 and Table 2); in the estimate under the short prediction period for the stocks added into the index, the only significant movement is on AD+4 with an increase of 68.6%. In the estimate under the long prediction period however, there were significant increases of 94.81%, 57.51% and 78.24% on days AD+1, AD+3 and AD+4, respectively and the increase on day AD+2 was close to significance. In the daily analysis made based on date of change, while no significant increase was identified in the estimate made under the short prediction period, a significant increase of 71.21% was identified on the day of change in the estimate made under the long prediction period. In the case of exclusion from the index, a decrease in the transaction volume of stocks is observed especially during the first two days. In the estimate made under the short prediction period, transaction volume went down by -11.85% on AD+1 and -10.02% on AD+2. Rates in the estimates made under the long prediction period are even lower as exemplified by a significant decrease of -25.93% was observed on day AD+2. In the period following the change date, large increases draw attention particularly on Change Day. Under the short prediction period an insignificant increase of 82.01%, under the long prediction period a significant increase of 92.86% were observed.

6.3. Special Cases: Şekerbank Example

When we look at the tables containing the cumulative abnormal return and transaction volume data of the stocks that were added (excluded) into (from) the

index, we understand that stocks have not had a general reaction to this change but some stocks have produced abnormal results. The main reason for these results is company specific events and conditions rather than the effects of being added (excluded) into (from) the index. Although these effects observed on stocks adversely affect the study, because these effects tend to balance each other out on aggregate and in order not to decrease the sample size even further, they have not been excluded from the analysis. Unexpected cumulative abnormal return and transaction volume results observed in Şekerbank stock have been examined in detail as a good example. Unexpected performances have also been observed in other stocks due to company specific reasons.

Şekerbank stock was added into the index in the 4th Index period of 2005. Despite having been added into the index, it had a high negative cumulative abnormal return. In the estimate made under the short prediction period, it had cumulative abnormal returns of -14.08% in the Announcement Period, -14.97% in the short run event period and -29.68% in the long run event period; in the estimates made under the long prediction period, -9.53% in the Announcement Period, -12.94% in the short run event period and -21.93% in the long run event period. The fact that it had a high negative abnormal return even in the estimate under the long prediction period confirms that the company had a rather unusual performance during the analysis period. Transaction volume rates and high t statistics values also reflect this situation. In the estimate made under the short prediction period, average transaction volume rates of 9.09% in the Announcement Period, 8.71% in the short run event period and 40.56% in the long run event period; in the estimates made under the long prediction period, 22.18% in the Announcement Period, 21.56% in the short run event period and 99.03% in the long run event period were observed. According to these results, transaction volume of the stock shows a recovery until 30 days after the change date.

When we look at the material disclosure statements the company sent to ISE, according to the material disclosure statement published on November 8, 2004 in the Stock Exchange Daily Bulletin, the sale on the exchange of 11.62% of Şekerbank shares out of a total 21.62% owned by Şekerbank T.A.Ş. Sosyal Sigorta Sandığı Vakfı, one of the main shareholder of the company, was permitted. Following this, on November 12, 2004, it was announced that the aforementioned shareholder had started to sell its shares on the exchange. After this date, abnormal price and volume movements were observed in the stock to the extent that its trade was suspended for two days.

These abnormal movements have affected the company to this day and the volatility of the stock, which was stable before this date, increased enormously after this date (See Graph 7 and Graph 8). It is believed that the real reason behind these movements is foreign investors' strong interest in the Turkish Banking Sector thanks to the high growth performance and atmosphere of confidence that was achieved in the aftermath of the 2001 crisis and the appearance of news about a possible acquisition of Şekerbank by the Dutch banking group, Rabobank International Holding BV (Rabobank). Graph 11 and Graph 12 show that after November 12, 2004, which is indicated on Graph 11 by a downward pointing arrow, price of the stock started a strong increasing trend and so did its transaction volume, which can be seen on Graph 12. The reason for the fall on the price graph in 2006 is the cancellation of the majority stake share purchase agreement with Rabobank and the reason for the increases in 2007 is the sale of the majority stake to another foreign investor, BTA Securities JSC. Therefore, it is believed that the main factor affecting the stock's price and its transaction volume during the prediction and analysis periods is the sale of its majority stake to foreigners.

Price and transaction volume movements observed in the company stock during the prediction and analysis periods are presented in Graph 13 and Graph 14 that start on March 15, 2005, which is the beginning date of the prediction period. The interval indicated by an arrow on Graph 13 covers the analysis periods. It is believed that the reason of the fall observed in the stock price during this period is the problems related to the sale of the majority stake.

The conclusion that can be derived from this analysis and graphs is the following: During the analyzed prediction period, the company was exposed to extraordinary developments and its β and VR values did not provide reliable results under the analysis period. It is believed that investors behaved according to the news of the majority stake sale, which they deemed more important and the announcement of inclusion of the stock in the index did not have an impact on investors.

VII. General Assessment and Conclusion

In this study, whether or not changes in ISE 30 Index composition had an effect on the return and transaction volume of stocks has been examined. A total of 60 additions to and exclusions from the index have been analyzed during the 6-year analysis period between 2005 and 2011. According to the findings, announcements of additions or exclusions and the actual changes do not have a

significant impact on stock prices. It would not be wrong to state that stock prices are not affected by announcements of change in index composition. The reason why being added into the index does not lead to higher returns is believed to be due to the fact that investors, already having the information about the criteria and the data used for selecting the stocks to be included in the index, anticipate the change early and price the stocks accordingly in advance. Furthermore, it can be concluded that financial products based on the index, including index funds, do not have a significant impact on stocks. On the other hand, both on the first day after the announcement and on the day of change; positive abnormal returns have been identified in case of additions into the index and negative abnormal returns have been identified in case of exclusions from the index. According to these findings, it can be stated that the effects of a change in index composition are observed on the announcement day and on the day of change. This gives us the impression of the existence of a market with semi-strong form efficiency. Because the results are not significant, it can be stated that none of the hypotheses that have been developed in the literature as alternatives to the Efficient Market Hypothesis is valid for the changes in ISE 30 Index.

It has been found that the change in index composition increases the transaction volume, although it has not produced significant results in the estimates made under the Short Prediction Period. It has also been found that, in general, additions into the index cause higher increases on transaction volume of stocks than exclusions from the index. While addition into the index increased the transaction volume on both announcement day and the day of change, exclusion from the index decreased the transaction volume on announcement day but increased it significantly on the day of change.

Since the methods and the data used by ISE for determining the changes in the composition of the index is publicly disclosed, investors take positions by anticipating in advance the stocks that would be added into or excluded from the index, thereby causing the information to be reflected in prices. Therefore, announcements of change regarding index composition do not lead to important changes in prices. Moreover, the fact that prices do not change much around the day of change can be attributed to the fact that there is only one index fund trading on ISE 30 Index and that this fund has a limited impact. Beneish and Whaley's (1996) "S&P Game", which is valid for the American market is not valid either.

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APPENDICES:
TABLES AND GRAPHS

* In tables, green arrows indicate statistically significant increase, red arrows indicate statistically significant decrease.

Table 1: Effect of Being Added into the Index on Stocks' Daily Performance

ABNORMAL RETURN							
Day	Short Prediction Period			Long Prediction Period			
	MAR (%)	t statistics	st.deviation	MAR (%)	t statistics	st.deviation	
AD+1	0.44	0.889	0.02694	0.48	0.927	0.02664	
AD+2	-0.55	-1.135	0.02589	-0.62	-1.174	0.02765	
AD+3	0.12	0.290	0.02152	0.20	0.506	0.02207	
AD+4	0.37	0.787	0.02497	0.32	0.906	0.01844	
AD+5	-0.45	-1.069	0.02266	-0.41	-0.871	0.02435	
CD	0.37	0.949	0.02122	0.41	0.999	0.02138	
CD+1	-0.28	-0.589	0.02601	-0.21	-0.394	0.02702	
CD+2	-0.53	-1.181	0.02402	-0.43	-0.949	0.02343	
CD+3	-0.20	-0.417	0.02637	-0.27	-0.573	0.02451	
CD+4	0.23	0.499	0.02466	0.11	0.252	0.02265	
CD+5	0.08	0.135	0.03291	0.30	0.466	0.0366	
CD+6	-0.05	-0.140	0.01982	-0.02	-0.065	0.0174	
CD+7	-0.26	-0.559	0.02484	-0.09	-0.193	0.02487	
CD+8	-1.00	-2.283	0.02359	-0.96	-2.263	0.02206	
CD+9	0.12	0.274	0.02414	0.27	0.551	0.02502	
CD+10	-0.54	-1.396	0.02075	-0.49	-1.232	0.02246	

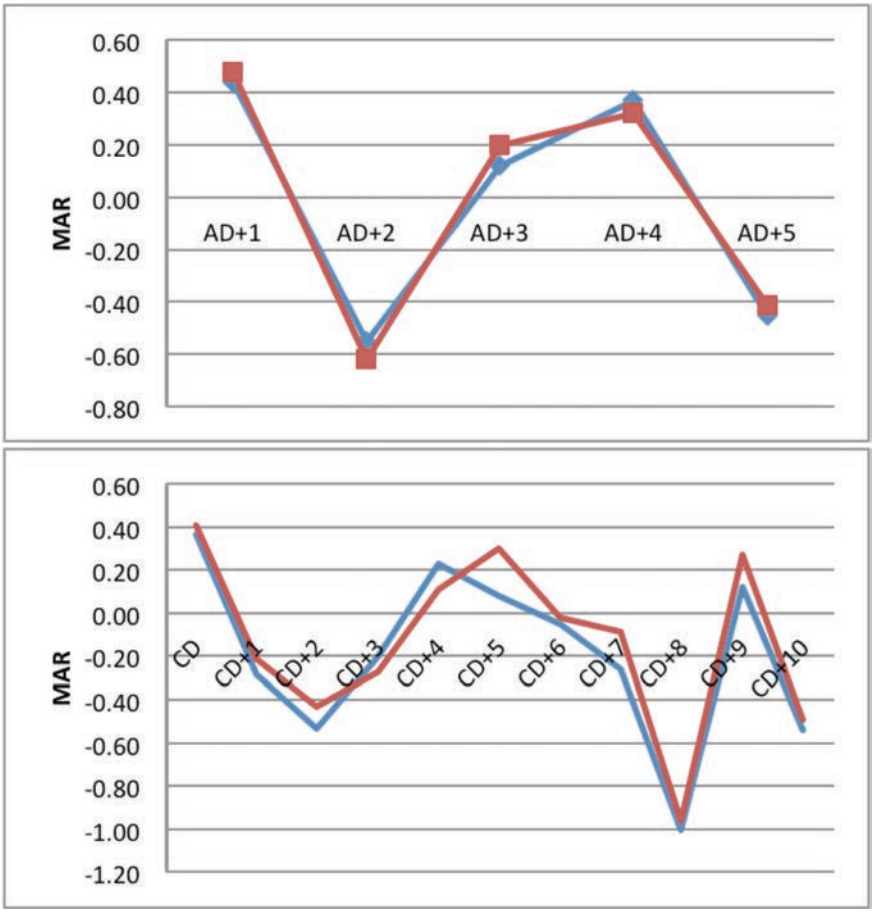
VOLUME RATIO						
Day	Short Prediction Period			Long Prediction Period		
	MVR	t statistics	st.deviation	MVR	t statistics	st.deviation
AD+1	1.3569	1.320	1.45589	1.9481	2.508	1.9642
AD+2	1.2673	1.040	1.38445	1.5604	1.980	1.5332
AD+3	1.1687	0.811	1.12039	1.5751	2.694	1.10928
AD+4	1.6860	1.332	2.77393	1.7824	2.880	1.4115
AD+5	1.5226	0.814	3.45816	1.2917	1.955	0.77522
CD	1.2160	0.892	1.30365	1.7121	2.324	1.59244
CD+1	1.0748	0.364	1.10727	1.4482	1.521	1.46358
CD+2	0.9926	-0.039	1.01833	1.5143	1.930	1.38507
CD+3	1.1217	0.604	1.08461	1.2659	1.304	1.0594
CD+4	0.9430	-0.392	0.78739	1.2056	1.298	0.82266
CD+5	0.7885	-2.162	0.52567	1.5138	1.653	1.61527
CD+6	0.8958	-0.870	0.64474	1.3811	1.415	1.39903
CD+7	1.0375	0.173	1.16902	1.5138	1.688	1.58176
CD+8	0.9543	-0.357	0.68894	0.9087	-0.659	0.70608
CD+9	0.6541	-3.842	0.47635	1.4103	1.354	1.57498

Table 2: Effect of Being Excluded from the Index on Stocks' Daily Performance

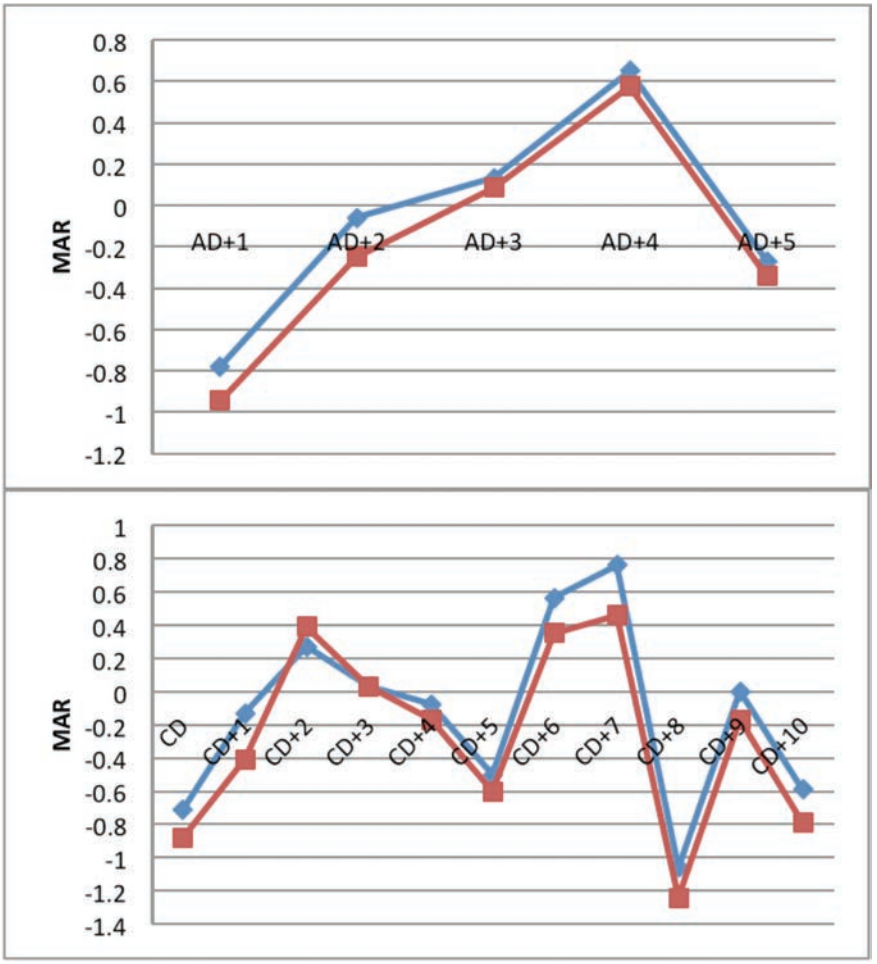
ABNORMAL RETURN						
Day	Short Prediction Period			Long Prediction Period		
	MAR (%)	t statistics	st.deviation	MAR (%)	t statistics	st.deviation
AD+1	-0.78	-3.272	0.01332	-0.94	-3.967	0.01299
AD+2	-0.06	-0.182	0.01933	-0.25	-0.722	0.01879
AD+3	0.13	0.325	0.02222	0.09	0.212	0.02238
AD+4	0.65	1.782	0.02047	0.58	1.584	0.0202
AD+5	-0.27	-0.997	0.01523	-0.34	-1.134	0.01624
CD	-0.71	-1.242	0.03188	-0.88	-1.490	0.03251
CD+1	-0.13	-0.292	0.0257	-0.41	-0.943	0.02384
CD+2	0.27	0.421	0.03619	0.39	0.615	0.03493
CD+3	0.03	0.067	0.02337	0.03	0.069	0.02164
CD+4	-0.08	-0.225	0.02008	-0.17	-0.461	0.02047
CD+5	-0.5	-1.274	0.02197	-0.6	-1.617	0.02038
CD+6	0.56	1.461	0.02132	0.35	0.905	0.02089
CD+7	0.76	1.911	0.02207	0.46	1.263	0.0201
CD+8	-1.06	-2.537	0.02325	-1.24	-3.043	0.0226
CD+9	0	0.009	0.01818	-0.17	-0.55	0.01709
CD+10	-0.59	-1.448	0.02264	-0.79	-1.976	0.0219

VOLUME RATIO						
Day	Short Prediction Period			Long Prediction Period		
	MVR	t statistics	st.deviation	MVR	t statistics	st.deviation
AD+1	0.8815	-0.836	0.78921	0.7633	-1.875	0.69161
AD+2	0.8998	-0.800	0.69763	0.7407	-2.203	0.64466
AD+3	1.0968	0.614	0.87664	1.0517	0.287	0.98744
AD+4	1.0896	0.571	0.87308	0.9328	-0.456	0.80758
AD+5	1.2061	1.017	1.12787	0.9734	-0.165	0.88473
CD	1.8201	2.026	2.25412	1.9286	2.167	2.34739
CD+1	1.199	1.277	0.84598	1.4999	1.622	1.68806
CD+2	1.0989	0.528	1.04282	1.096	0.541	0.97308
CD+3	1.1008	0.689	0.81519	0.9733	-0.124	1.17807
CD+4	1.1788	0.951	1.04653	0.9136	-0.702	0.67375
CD+5	1.1592	1.006	0.8808	1.0688	0.276	1.36396
CD+6	1.2851	1.217	0.233	1.0541	0.262	1.13339
CD+7	1.4011	1.163	1.92016	1.0562	0.279	1.10455
CD+8	1.1686	1.109	0.8328	1.3803	0.7	2.97741
CD+9	1.1065	0.754	0.78703	1.037	0.194	1.02494
CD+10	0.9775	-0.171	0.73517	0.9189	-0.565	0.78508

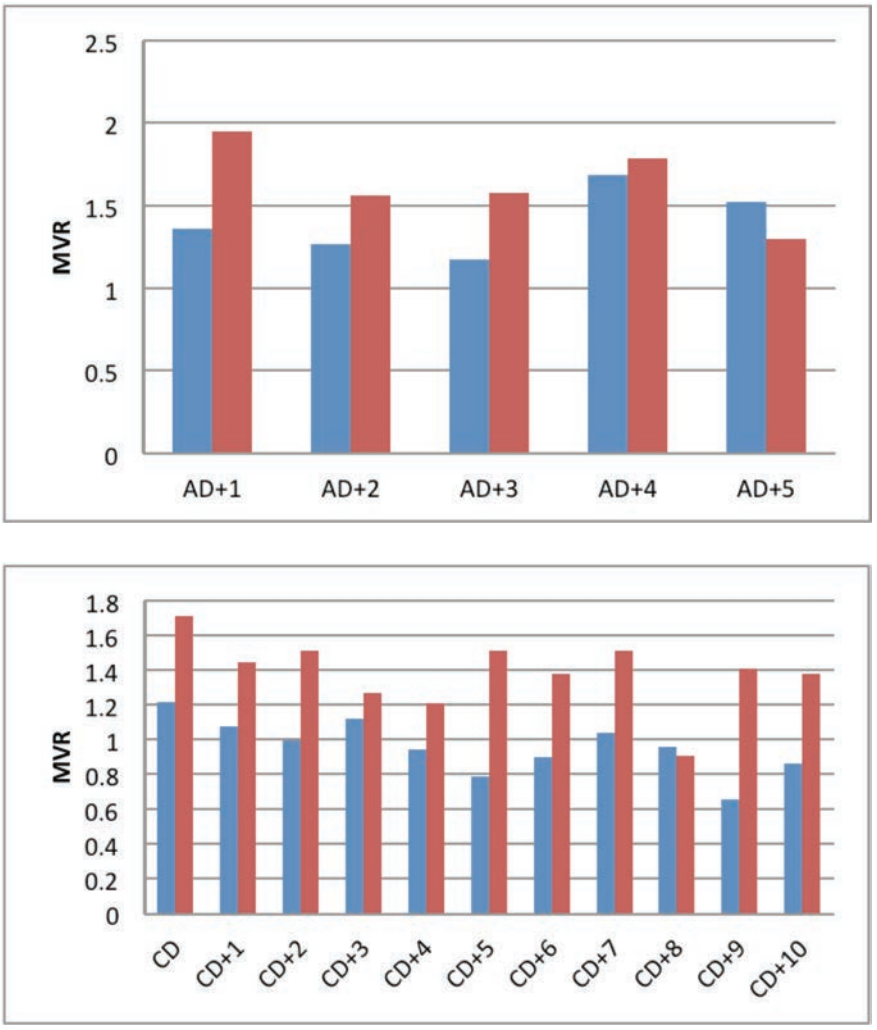
Graph 3: Effect of Being Added into the Index on Daily Returns



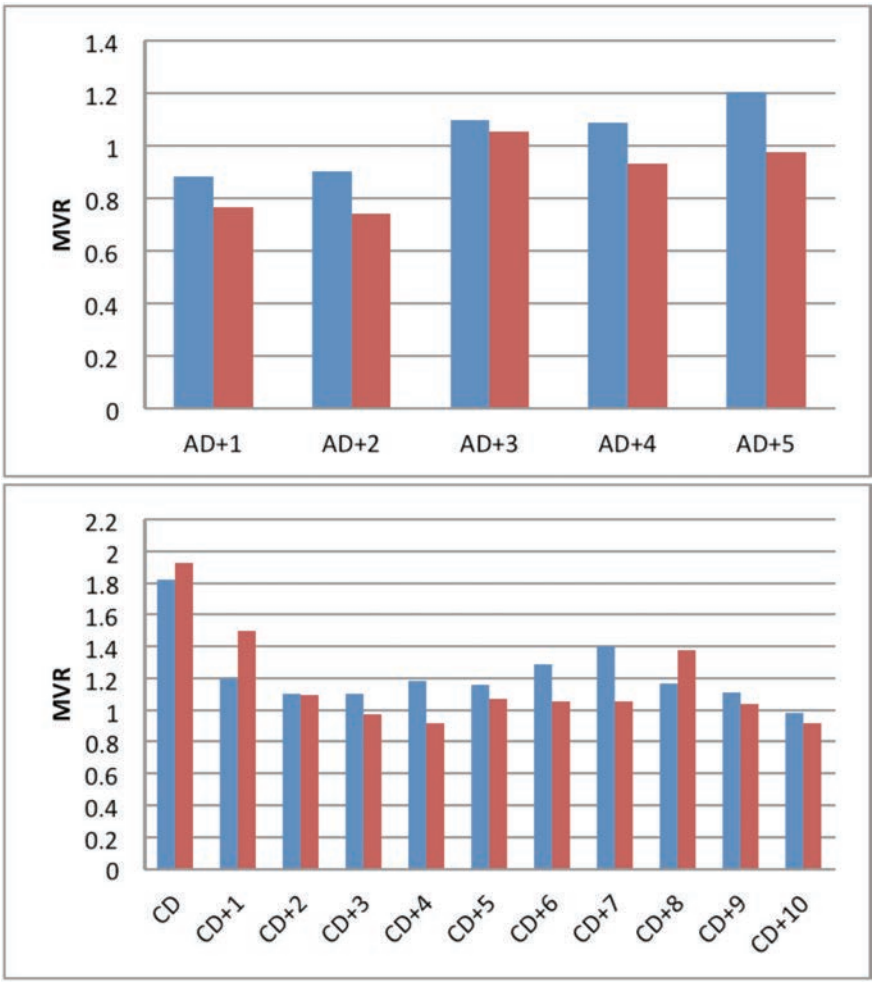
Graph 4: Effect of Being Exculuded from the Index on Daily Returns



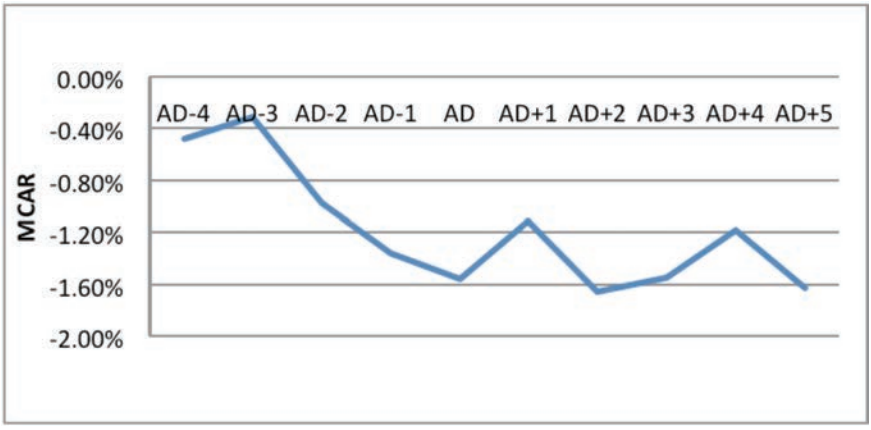
Graph 5: Effect of Being Added into the Index on Daily Transaction Volume



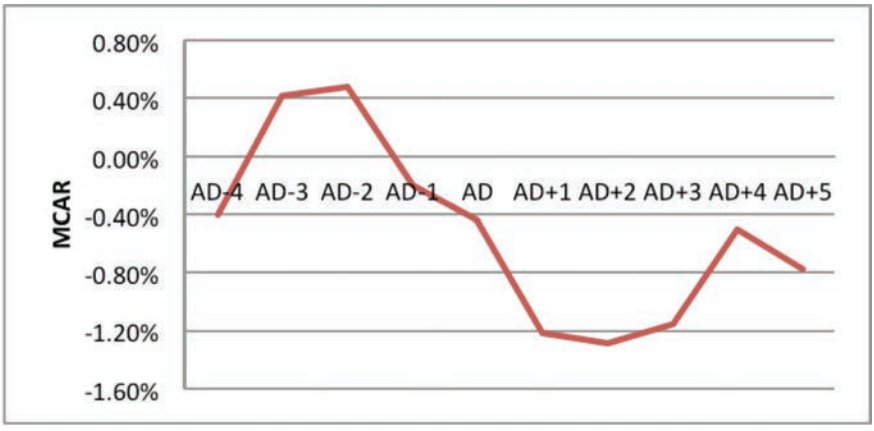
Graph 6: Effect of Being Added into the Index on Daily Transaction Volume



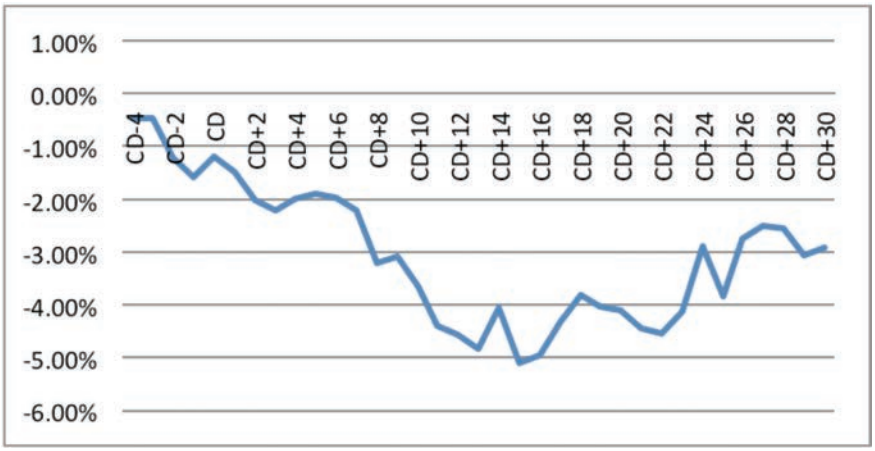
Graph 7: Cumulative Abnormal Return of Being Added into the Index under the Short Prediction Period during the Announcement Period



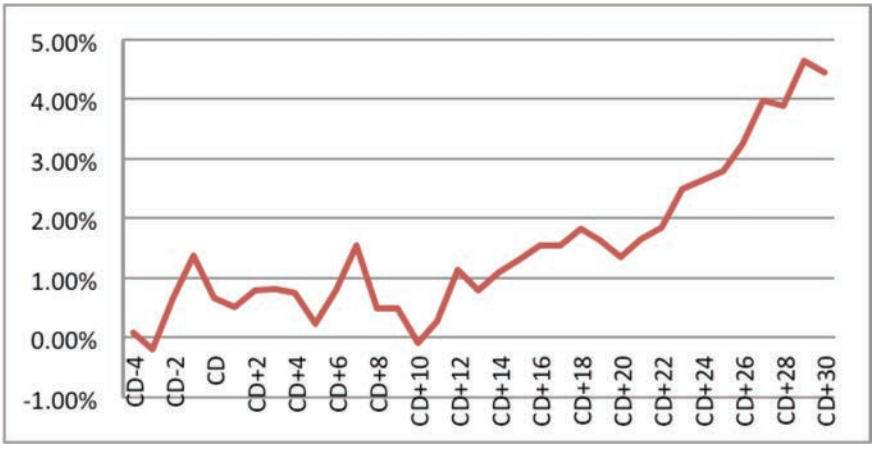
Graph 8: Cumulative Abnormal Return of Being Excluded from the Index under the Short Prediction Period during the Announcement Period



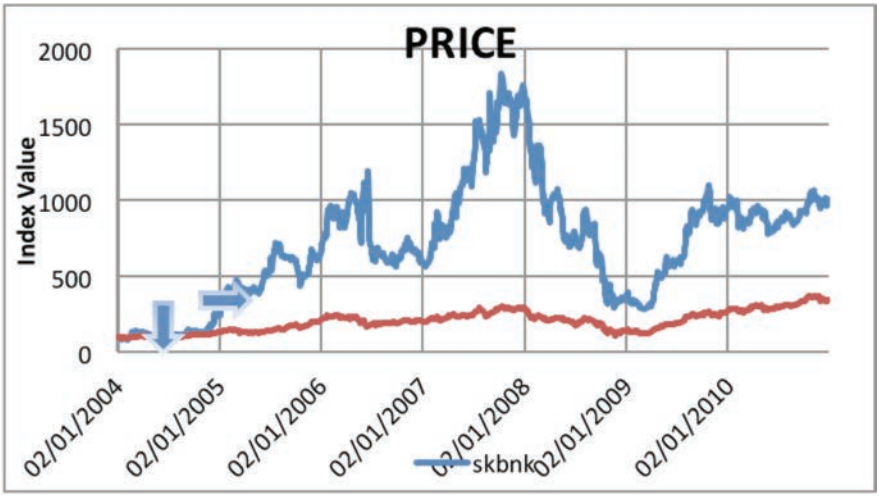
Graph 9: Cumulative Abnormal Return of Being Added into the Index under the Short Prediction Period during the Long Run Event Period



Graph 10: Cumulative Abnormal Return of Being Excluded from the Index under the Short Prediction Period during the Long Run Event Period

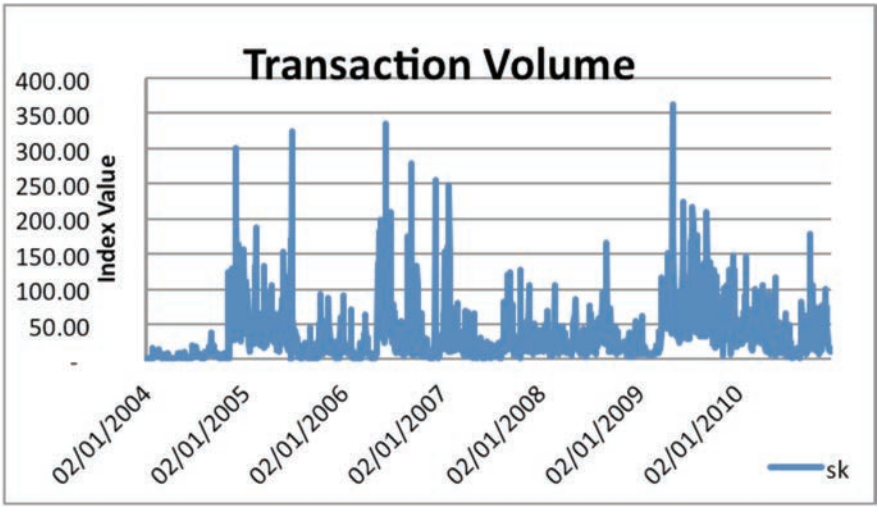


Graph 11: SKBNK-XU100 Long Run Price Indices (Initial Value: 100)



* Price of SKBNK stock and ISE 100 index have been started from the value of 100 as of January 2, 2004

Graph 12: SKBNK Long Run Transaction Volume Index (Initial Value: 100)

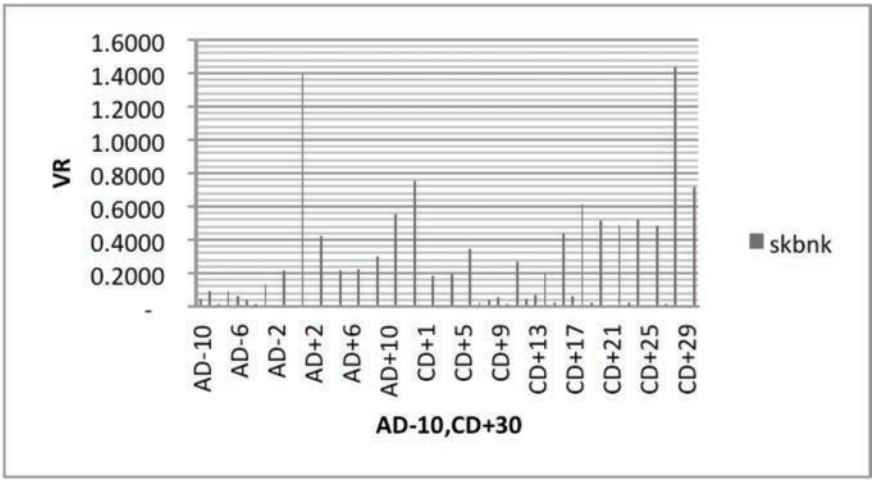


* Transaction volume data of SKBNK stock has been converted into an index with an initial value of 100 as of January 2, 2004

Graph 13: SKBNK-XU100 Short Run Price Indices (Initial Value: 100)

* Price of SKBNK stock and value of ISE 100 index have been started from the value of 100 as of March 15, 2005.

Graph 14: SKBNK Short Run Transaction Volume Rates



The ISE Review Volume: 13 No: 51
ISSN 1301-1642 © İMKB 1997

HOUSING MARKET AND MACROECONOMIC FUNDAMENTALS

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Abstract

This paper uses vector error correction model (VECM) to identify the impacts of fundamental macroeconomic factors on the demand and supply sides of the Turkish housing market, between October 2007 and December 2011. Many researches argue that housing market and macroeconomic fundamentals such as interest rate, gross domestic product (GDP), housing prices and some others are cointegrated. In the light of the evidence on two cointegrating equations, error correction model is estimated to examine the effect of the variables on housing demand and supply in Turkey. While the dependent variable in demand side is mortgage credit volume, the dependent variable that is used to explain the supply side is construction permit. The study reveals that the macroeconomic variables have different impacts on the dynamic behavior of mortgage credit and construction permit. Additionally, the impulse response analysis which is based on structural VECM suggests that the housing market in Turkey is sensitive to the shocks in the economy. This paper also presents forecast error variance decompositions (FEVD) and indicates the important role of GDP per capita on mortgage credit in the long run.

Keywords: Housing supply, housing demand, cointegration, Turkey
JEL Classitication: C51, R31

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1. Introduction

The housing market is one of the most interesting research fields since it is among the fundamental factor which sheds light on the whole economy. Two sides of housing market, demand and supply, interact to determine the prices of housing. On the other hand, economic activities and prices may affect the demand and supply side of housing market. The efficacy of the demand side approach depends upon the size of the elasticities of macroeconomic fundamental factors of the demand for housing. In addition to the macroeconomic determinants, the factors of production in the housing industry are one of the leading indicators for housing supply. Since it is not possible to distinguish housing market from whole economy, there are several studies and methods to examine housing market.

There are mainly two different approaches to investigate housing market; examination of house prices and analyzing the demand and supply side of the housing market. Several studies examine how house prices are affected by the changes of macroeconomic fundamentals such as interest rate, income, etc. The general idea on this issue is to add supply and demand side variables to house prices function. Durmaz (2011) argues that the most efficient analysis can be obtained when both sides will be added to the analysis. Similarly, Chen and Patel (1998) model the house prices dynamics as a function of the supply and demand side variables such as total household income, house completions, construction cost, short-run interest rate, stock price index. Abelson et. al. (2005) explain the changes in real house prices in Australia. They find that income, unemployment rate, real mortgage rates, equity prices and consumer price index are elastic to house prices.

Besides, several other studies have also examined the housing market from the point of supply and demand side analysis. To overcome the uncertainty of income elasticity on housing demand, De Leeuw (1971) examines the relationship between housing demand, income and house prices by doing cross sectional analysis. According to the results, income elasticity of housing demand is positive. Additionally, Schwab (1983) proposes three different views of the relationship between expected inflation and the demand for housing. He concludes that demand is not only a function of nominal interest rate but also a function of expected inflation and real interest rate. Carliner (1973) investigates income elasticity of housing demand by using panel regression analysis. All the income elasticity estimates are significant and between zero and one which does not depend on

the income definition. Additionally, Glennon (1989) examines the elasticities of income, prices and interest rate to housing demand by using time series data. He finds that income elasticity of housing demand is positive whereas price and interest rate elasticities are negative. Apart from the demand side, there is a large literature on modeling the housing supply of new homes. Topel and Rosen (1988) argue that current asset prices are sufficient statistics for housing investment if short-run and long-run investment supply is the same. If the cost of production is affected by the changes in the level of construction activity, then supply is less elastic in the short run than the long run.

Other research methodologies in use are cointegration and VECM to understand the housing market. On the one hand, there are some studies, like Hofmann (2001) and Brissimis and Vlasssopoulos (2009), which find one cointegration and cover the demand side of housing market. Hofmann (2001) analyses the relationship between bank lending and property prices respectively for Hong-Kong and for a set of industrialized countries. He concludes that long- run and short-run causality goes from property prices to bank credit. According to the results of Brissimis and Vlasssopoulos (2009), a line of causality running from housing loans to housing prices in the long run is not confirmed. In the short run, however, the analysis provides a contemporaneous bi-directional dependence among housing loans and housing prices. While the availability of credit increases, the demand for property will rise, as well. Based on the fixed amount of real estate supply in the short-run, the real estate prices will tend to go up.

On the other hand, several studies expand the examination and cover not only the demand side of housing market but also the housing price dynamics. Gimeno et. al. (2006) examines dynamic interaction between house prices and mortgage credit in Spain. He identifies two cointegration relationships and whose dependent variables are interdependent in the long-run. Another study which is examined by Valverde and Fernandez (2010) covers both mortgage credit and house prices and finds that interest rate influences lending and house prices in the same direction, whereas house prices has negative effect on mortgage credit and real salary has negative effect on house prices. Finally, Kenny (1999) and Meese and Wallace (1994) employ cointegration techniques to discover the long run relationships among the housing fundamentals. Using housing completions as demand side, real housing prices and nominal mortgage rates are found to be cointegrated.

Higher interest rate decreases housing demand whereas increases prices. Meese and Wallace (1994) have concluded that the speed of adjustment after a demand shock in the Paris dwelling market was about 30% per month.

Even though there are many studies related to housing market in the literature, few studies are done in Turkey because of the lack of house prices data. Bulut (2009) investigates both demand and supply side by using cointegration analysis. Even though she finds the expected signs in both sides, this study is controversial for Turkish housing market because she uses value of dwellings as a proxy for house prices.

In this study, we analyze supply and demand side of housing market by using mortgage credit volume as demand side and construction permit as supply side variables. Our contribution to the literature is the analysis of the effects of macroeconomic factors on the housing credit and construction permits. Concerning the active interventions of Central Bank of Turkey on credit markets together with recently adopted renovation policies by Ministry of Environment and Urbanization, the simultaneous control of interest rates policies and construction permits is of crucial importance. We show that the outline of the paper is as follows: Section 2 outlines the data and econometric methodology. In Section 3, an attempt is made to give estimation results and finally Section 4 covers the conclusion.

2. Data And Econometric Methodology

2.1. Data

We use monthly data from October 2007 to June 2012 and the reason for this limited range is the absence of the house price data for Turkey. The data which does not have this frequency is converted using the quadratic matching method. The logarithms of data are used for all calculation.

Mortgage credit volume which represents the demand side of housing market is taken from Banking Regulation and Supervision Agency (BDDK). As we said above construction permit is used as supply side of housing market and is obtained from Turkish Statistical Institute (TUIK). Current Gross Domestic Product which is the proxy for disposable income is calculated and announced by TUIK. Interest rate is taken from Risk Türk-Risk Software Technologies. House price data which has been recently announced by Reidin is obtained from that company. Finally, we use construction cost index which is provided by TUIK. In addition to that,

since there is an outlier in the construction permit, because of a specific law we use "dumper" as dummy variable for December 2010.

The descriptive statistics and abbreviations of the variables are given as logarithmic forms in Table 1.

Table 1: Definition and Descriptive Statistics of the Variables

Symbol	Definition	Mean	Median	Max.	Min.	St. Dev.
cr	Mortgage Credit	16.64	16.58	17.09	16.15	0.29
per	Construction	10.80	10.74	12.54	10.32	0.35
hp	House Prices	4.55	4.55	4.67	4.45	0.06
int	Interest Rates	0.12	0.09	0.22	0.07	0.05
cc	Construction Cost	5.00	4.97	5.15	4.82	0.09
gdppc	GDP per capita	7.17	7.13	7.42	6.97	0.14

The graph of mortgage credit volume and construction permit is given as logarithmic forms in graph 1. As it can be seen from graph, mortgage credit volume increases dramatically during the specific period. Even though construction permit fluctuates around level, it has one outlier due to a legal adjustment made in December 2010. This adjustment which restricts the amount of credit taken from banks caused a huge increase in permits before its implementation.

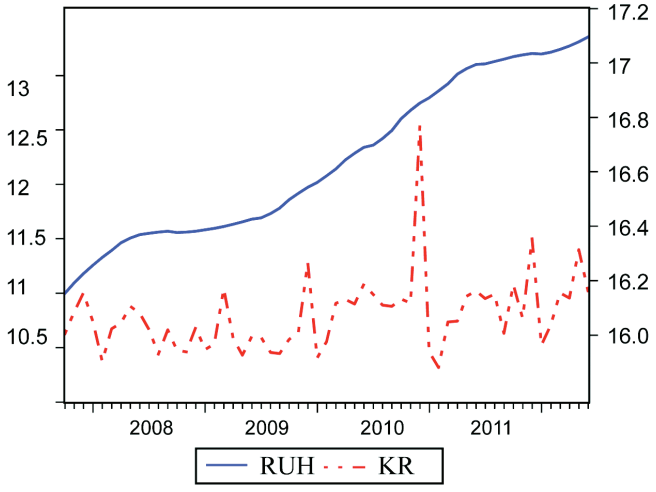

Figure 1: Mortgage Credit Volume (CR) and Construction Permit (PER)

2.2 Theoretical Consideration (Model)

One of the main approaches of housing sector in a given economy is to construct a model for demand and supply of housing market using the related variables in that economy. Demand function can be describe

$$Q_t^D = f(P_t, X_t) \quad (1)$$

where P_t is housing prices and X_t constitutes the demand side control variables.

Other determinants of the market are represented in housing supply function which is,

$$Q_t^S = g(P_t, Y_t) \quad (2)$$

Where P_t is housing prices and Y_t reflects the other supply side variables.

According to the economic theory, the economic activities such as interest rate and house prices may effect on mortgage credit demand. Consumption and investment will change based on the economic conditions and expectations. Therefore, mortgage credit demand may be influenced by interest rate and house prices. If the interest rate increases, mortgage credits will be more costly. Hence, demand of mortgage credits will reduce which means that there is a negative relation between interest rate and mortgage credit. In addition, housing is an ordinary good in a market which does not have any restriction on mortgage credit. In other words, the house prices and housing demand have negative relation. Furthermore, GDP per capita which is a proxy for income is positively correlated with housing demand because the individual who has more income wants to buy new houses either to increase the income by taking rent from each additional home or to raise the living standards. In the supply side, the builders will raise the amount of supply if the house prices increase. On the other hand, since the builder wants to maximize the profit, an increase of the construction cost causes a decrease of the housing supply. In addition, if the interest rates go up, the opportunity cost of supplying new home will increase. Therefore, there is a negative relation between interest rate and housing supply.

2.3 Econometric Method

OLS estimation method for any model is ruled out since some of the variables in the model are not stationary. When the variables in the system are non-stationary (Integrated of order 1, I (1)), then the system can be generalized to the multi-variable error correction method which is called VECM (Vector Error Correction Model) and it can be written as,

$$\Delta y_t = \Pi_0 + \Gamma y_{t-1} + \Pi_1 \Delta y_{t-1} + \ldots + \Pi_p \Delta y_{t-p} + \Psi_0 x_t + \ldots + \Psi_q x_{t-q} + \Phi D_t + \varepsilon_t \qquad (3)$$

where Π_o is (nx1) vector of intercepts, Π_i's are (nxn) matrices of short-run coefficients, Γ is (nxn) structural matrix and ε_t is (nx1) vector of disturbance terms. Also, x_t and D_t refer to exogenous variables with lag order q and dummy variables, respectively.

Since the variables in the system are cointegrated I(1) and has reduced rank (r) so, Γ can be written as $\Gamma = \alpha\beta'$ where α is (nxr) matrix of adjustment coefficients and β is (nxr) matrix of cointegrating coefficients.

Johansen (1988) develops a procedure to define the cointegrating relation in a multi-variable system. The main purposes of the Johansen procedure are first to determine the number of cointegrating vectors and then to provide the maximum likelihood estimators of determined cointegrating vectors.

Generally, the procedure starts with a test to obtain the order of integration of variables. All variables must be I(1); because any I(0) variable in the model creates additional cointegration relationship and the variables which have different order of integration cause some complications. To determine whether the variables are I (1) or not, unit root tests such as Augmented Dickey Fuller test can be used. Second step is to choose the optimal lag length using an information criterion. The appropriate lag length p can be chosen by minimizing the,

$$SC(p) = \log\det(\tilde{\sum}(p)) + \frac{\log T}{T} p n^2 \qquad (4)$$

where $\tilde{\sum}(p)$ is estimated by $T^{-1}\sum_{t=1}^{T}\hat{\varepsilon}_t\hat{\varepsilon}_t'$ and $\hat{\varepsilon}_t$ is estimated residual vector in equation (3).

Afterwards, one can include deterministic components in the cointegration relations. For different model setups, specific deterministic terms such as intercept and trend place in the model with respect to some economic intuitions.

After the number of cointegrating vectors (r) is estimated with using trace test statistics, conditions for identification of the model must be checked. The identification condition is met when the total number of restrictions (k) is at least the square of the number of cointegrating vectors (r^2). Also, for the just identified model, the number of restrictions on each cointegrating vector must be equal to the number of cointegrating vectors (Pesaran and Shin (2002)). Restrictions place on matrix. So both and matrices can have required restrictions. Additional restrictions means over-identification restrictions on the adjustment coefficients (α) and/or the cointegrating coefficients (β) can be tested using χ^2 statistics. Restrictions on matrix form are provided in the linear form. Moreover, restrictions on the adjustment coefficients are imposed if a variable is weakly exogenous means that adjustment coefficient of that variable is not significant.

Another implication of VECM method in econometric analysis is impulse response functions. Lütkepohl (2005) shows an MA representation of the VECM is,

$$y_t = \Xi\sum_{i=1}^{t}\varepsilon_i + \sum_{j=0}^{\infty}\Xi_j^*\varepsilon_{t-j} + y_0^* \tag{5}$$

where

$$\Xi = \beta_\perp'[\alpha_\perp'(I_n - \sum_{i=1}^{p}\Pi_i)\beta_\perp]^{-1}\alpha_\perp' \tag{6}$$

and y_0^* contains all initial values

Rukelj (2010) uses B model for identification purposes where,

$$e_t \sim (0, I_n) \rightarrow \sum_{\varepsilon} = BB' \quad (7)$$

With B matrix, model has at most r (number of cointegrating vectors) shocks with transitory effects which mean that shocks have zero long-run effects. So there are at least n-r shocks have permanent effects (Lütkepohl et. al., 2004).

Matrix B can be identified if it has n^2 restrictions. Normalization of $\sum_{\varepsilon}$ imposes n(n+1)/2 restrictions. Number of transitory shocks (r) provides r(n-r) independent restrictions. For the identification of the permanent shocks, (n-r)(n-r-1)/2 additional restrictions are needed and similarly r(r-1)/2 additional restrictions have to be provided for the identification of transitory shocks.

3. Estimation Results

3.1 Data Analysis

According to the discussion in the previous section, we need to check whether the variables are integrated of order one or not. Table 2 and Table 3 in the appendix shows the augmented Dickey-Fuller (ADF) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test results. According to these tests, the null hypothesis of an existence of unit root cannot be rejected in levels, but rejected in the first differences. We conclude that all variables are integrated of order one. We find that the optimal endogenous lag is two according to Akaike Info criterion and Hannan-Quinn criterion. Therefore, we prefer to use two lags in VECM.

3.2 Johansen Cointegration Test Results

Given the results above, we estimate one order VAR in order to determine the number of cointegrating relationships. We concentrate on the trace test while testing for cointegration since it is more common test to decide the number of cointegration. Using Johansen Cointegration Test, two cointegrated vectors are found which explain the long-run relationship between housing sector variables. (The results are reported in Table 4 in the appendix.) To find the cointegrated vectors we need to put at least two restrictions to each vector.

According to the discussion in the previous section, in the long run we expect that mortgage credit volume, as demand side, is related with house prices, interest rate and GDP per capita. On the other hand, as supply side, construction permit is correlated with the house prices, interest rate and construction cost in the long run.

The first cointegrated vector can be attributable to the long run relationship between the demand side of housing market and the macroeconomic variables, whereas the second one can be attributable for supply side of the housing market. To construct the cointegrating vectors, we should put some restrictions according to the economic intuitions. In the demand side (equation (8)), when the GDP per capita, which is a proxy for income, increases the household wants to buy new homes to increase his income by taking rent or to raise his standard of living. On the other hand, as house prices increase, housing demand is expected to decrease. In the supply side (equation (9)) of the housing market, the supplier wants to maximize his profit. While the construction cost increases, the willing of the builder to supply will raise, which means there is a negative relation between housing supply and construction cost. A negative sign is expected on interest rate in housing supply equation, since suppliers have to pay more interest to have enough capital to build a house. House prices, however, have positive effect on housing supply since it may be more profitable than the other investments. The cointegration vectors are as follows;

$$Co\,\mathrm{int}\,1: kr_{t-1} = 7.247 - 0.002trend - 1.147hp_{t-1} + 0.205\,\mathrm{int}_{t-1} + 2.025gdppc_{t-1} \quad (8)$$

$$Co\,\mathrm{int}\,2: per_{t-1} = 8.081 + 0.011trend + 2.157hp_{t-1} - 2.262\,\mathrm{int}_{t-1} - 1.435cc_{t-1} \quad (9)$$

The results in the cointegration vector allow us to comment how the variables are connected in the long run. The aim of the deterministic trend in the cointegration equations is to capture the behavior of trend stationary variables (Kaufman and Cleveland (2001)). As the previous studies (Hofmann (2001), Gimeno et. al. (2006), Brissimis and Viassopoulos (2009), Valverde and Fernandez (2010)) suggest we normalize mortgage credit volume and the first cointegrating vector can be debated as demand side of housing

market. Assuming the coefficients of the first equation is representing the demand side equation, the signs except interest rate are consistent with the findings for Ireland. (Kenny, 1999) Other than that, there are several studies to find the same relation. Hofmann (2001) examines the relation among bank credit, real price, real GDP and real interest rate in the industrialized countries and concludes that real GDP has a positive and significant effect on housing demand. Also, Gimeno et. al. (2006), Brissimis and Viassopoulos (2009), Valverde and Fernandez (2010) reach a consensus on the positive relationship between income and housing demand. The negative sign of house prices in the demand equation is consistent with the findings of Kenny (1999). The sign of interest rate in the demand equation conflicts with the results of other studies. However Alper et. al. (2011) reveal that interest rate does not have an effect on mortgage credit. Therefore, we think that the sign together with insignificant coefficient makes sense. Second cointegrating vector, which is established as supply side, has consistent coefficients' signs for house price and construction cost with the study of Topel and Rosen (1988).

3.3 Vector Error Correction Model

Error correction model sheds us light to understand the relationship between the variables in the short run. The coefficients of the speed of adjustment help us to analyze whether the short run dynamics converge to the long-run dynamics by following an increasing path or decreasing path. Furthermore, they show the speed of convergence and since we care about the demand and supply side we only discuss the loading coefficients for the demand and supply side equations.

The Vector Error Correction Models (VECM) are as follows;

$$\Delta cr_t = \underset{(-3.612)}{-0.007}\, co\,\mathrm{int}2_{t-1} + \underset{(25.210)}{0.912}\,\Delta cr_{t-1} \tag{10}$$

$$\Delta per_t = \underset{(4.029)}{3.536}\, co\,\mathrm{int}1_{t-1} - \underset{(-11.871)}{1.369}\, co\,\mathrm{int}2_{t-1} - \underset{(-3.825)}{11.779}\,\Delta hp_{t-1} + \ldots$$

$$\ldots + \underset{(2.484)}{0.184}\,\Delta per_{t-1} - \underset{(-3.243)}{6.703}\,\Delta gdppc_{t-1} + \underset{(9.472)}{1.679}\, dumruh_t \tag{11}$$

where the numbers in parenthesis represents t values. In the VECM model, we only analyze mortgage credit volume and construction permit in difference forms. In accordance with the "general-to-specific" approach,

we only show the coefficients of significant variables. In the equation (10), we observe a short-term positive and significant effect of first lag of the mortgage credit volume on itself. The lag in the correction for disequilibrium in the housing supply market also acts as a mechanism for correction of actual mortgage credit volume, whereas the lag in the correction for housing demand market appears to have no impact. According to the equation (11), we observe a short-term negative and significant effect of house prices and GDP per capita on construction permit. Interest rate, however, has positive and significant effect on construction permit. In addition to that, the loading factors are significant which implies that there exists adjustment of construction permit to disequilibria of the housing demand and supply markets. Furthermore, the VECM residuals are diagnosed for serial correlation, normality and ARCH, and the results of diagnostic tests are reported in Table 5 in the appendix. The residuals of both mortgage credit and construction permit provide normality and the diagnostic test results indicate that the model we use does not suffer serial correlation and ARCH effects.

3.4 The Structural Model

In this part, we estimate a structural vector error correction model (S-VECM) as mentioned in the empirical section. Also, the impulse response analysis is applied to the model by using the estimation results. Our model is considered for 6 variables, that is $n = 6$. Also, we find 2 cointegration relations in the previous part, $r = 2$. All these information brings up to model as two transitory and four permanent shocks. Therefore, for just identified model, we need $\frac{n(n-1)}{2} = 15$ linear independent restrictions. Because cointegration relations are assumed to be stationary, temporary shocks accompanied with mortgage credit volume and construction permit variables. The restrictions are imposed on the first and second columns of the long- run impact matrix (ΞB). Because, this matrix has reduced rank property, this means only $r(n-r) = 8$ restrictions are imposed. Then, for the identification of the permanent shocks, it is necessary to put additional restrictions on $\frac{(n-r)(n-r-1)}{2} = 6$ elements. We assume that interest rate variable is determined out of our model so we put zeros to the fourth row of

the long run impact matrix. Additionally, it is assumed that the house prices variable does not have any permanent effect on GDP per capita. Furthermore, we follow the assumptions which are used in cointegration equations. So, the construction cost index does not have an effect on the mortgage credit volume and GDP per capita has no influence on the construction permit. These assumptions provide us to set associated elements to zero. Furthermore, $\frac{r(r-1)}{2}=1$ additional restriction is required to identify the transitory shocks. This last restriction takes place on estimated contemporaneous impact matrix (B) because we assume that mortgage credit volume shocks do not push out an immediate effect on construction cost. Hence, the restrictions on the contemporaneous impact matrix (B) and the long-run impact matrix (ΞB) are given by;

$$B=\begin{array}{c}\begin{matrix}cr & per & hp & int & cc & gdppc\end{matrix}\\ \begin{pmatrix} * & * & * & * & * & * \\ * & * & * & * & * & * \\ * & * & * & * & * & * \\ * & * & * & * & * & * \\ 0 & * & * & * & * & * \\ * & * & * & * & * & * \end{pmatrix}\end{array} \qquad (\Xi B)=\begin{array}{c}\begin{matrix}cr & per & hp & int & cc & gdppc\end{matrix}\\ \begin{pmatrix} 0 & 0 & * & * & 0 & * \\ 0 & 0 & * & * & * & 0 \\ 0 & 0 & * & * & * & * \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & * & * & * & * \\ 0 & 0 & 0 & * & * & * \end{pmatrix}\end{array}$$

The imposed restrictions on (B) and (ΞB) help us to estimate our structural vector error correction model, as follows;

$$B=\begin{pmatrix} 0.9058 & 1.2561 & -0.7271 & 1.0475 & 0.2956 & 0.4353 \\ 2.3035 & 2.2335 & 0.4760 & -1.6043 & 1.2689 & 0.1409 \\ 0.0000 & 0.0000 & 0.3373 & -1.2370 & -0.4609 & 0.1849 \\ 0.0000 & 0.0000 & 0.0000 & 0.0000 & 0.0000 & 0.0000 \\ 0.0000 & 0.0000 & -0.0460 & -1.5207 & 0.6553 & -1.3530 \\ -7.2756 & -10.1302 & 2.6234 & 0.8670 & -0.4893 & 2.5258 \end{pmatrix}$$

$$\Xi B = \begin{pmatrix} 0.0000 & 0.0000 & -2.7281 & 6.5789 & 0.0000 & 9.4522 \\ 0.0000 & 0.0000 & 4.4102 & -8.7889 & -5.6447 & 0.0000 \\ 0.0000 & 0.0000 & 2.3794 & -8.7252 & -3.2511 & 1.3043 \\ 0.0000 & 0.0000 & 0.0000 & 0.0000 & 0.0000 & 0.0000 \\ 0.0000 & 0.0000 & 0.5040 & -6.9953 & -0.9544 & 1.9616 \\ 0.0000 & 0.0000 & 0.0000 & -1.6910 & -1.8404 & 5.4052 \end{pmatrix}$$

3.4.1 Impulse Response Analysis

Impulse response analysis is used to analyze the interactions between the variables in our model. The figures below demonstrates that how a variable responds to one standard deviation shock on each variable. In our analysis, we focus on the responses of two variables such as mortgage credit volume and construction permit to impulses on all variables. Since the shocks on mortgage credit volume and permit have transitory effects, the impulse responses of mortgage credit volume and permit die out after some period. In this section, firstly demand side shocks and responses will be investigated, then a supply side analysis will be shown.

The response of the mortgage credit volume to house prices shock, which can be seen in Figure 2, demonstrates that house prices shock affects the mortgage credit volume negatively both in the short run and long run. There is an evidence for the escape behavior of people from the credit market when a shock comes to the house prices. This type of behavior is not very effective in a very short run, but its effect increases as periods go by. In between 3th and 7th periods, the shock picks up some positive effect but then it dies out and house price shock causes mortgage credit volume to decrease permanently in the long run.

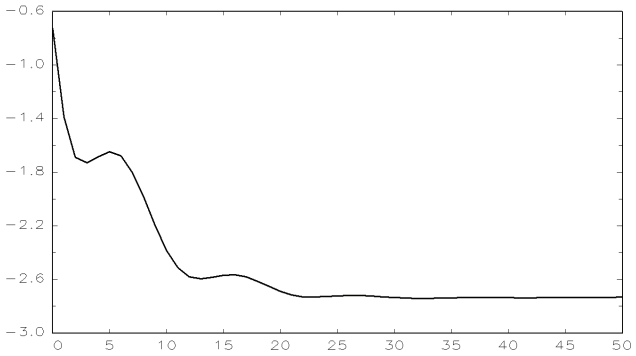

Figure 2: Response of Mortgage Credit Volume to a Shock on House Prices

Figure 3 displays how the mortgage credit volume is affected by the one standard deviation shock on interest rate. However, since the coefficient of the interest rate in equation (8) is not significant, this response may be omitted.

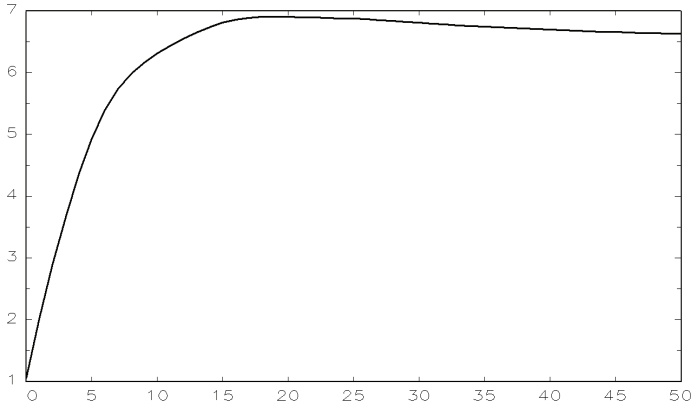

Figure 3: Response of Mortgage Credit Volume to a Shock on Interest Rate

Figure 4 demonstrates that how a shock on GDP per capita shock affects the mortgage credit volume. The response is positive and increasing in the short and medium run. It reaches to a permanent level after 45 periods. The results seem intuitive since a positive shock on the level of income may lead people to save more and hence it boosts the credit market.

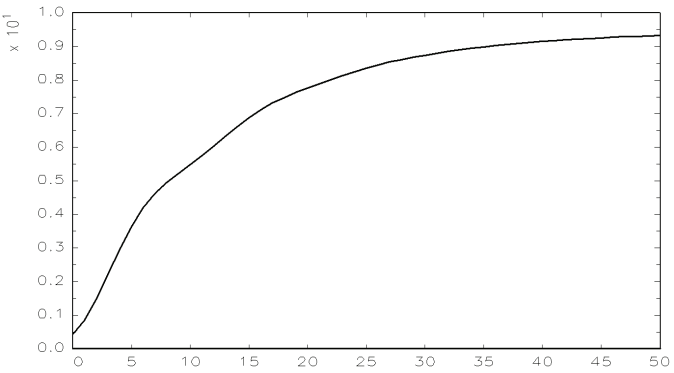

Figure 4: Response of Mortgage Credit Volume to a Shock on GDP per capita

After we analyze the demand side effects of shocks, we now look at the supply side of the model. Initially, the effect of house prices shock on the construction permit is displayed in Figure 5. Initial response of construction permit to house prices shock is negative. This response may appear due to misperception of construction market. Constructors may perceive that this is a shock on general price levels, so they may reduce the construction activities. Even though the response is changing and osculating in the medium run, the effect of house prices shock on the construction permit is positive in the long run. After one year period, response of the shock gets through its positive permanent level. That is to say, a shock on house prices increases the housing starts. The positive relationship between house prices and construction permit in our model supports the general supply relation between prices and quantity.

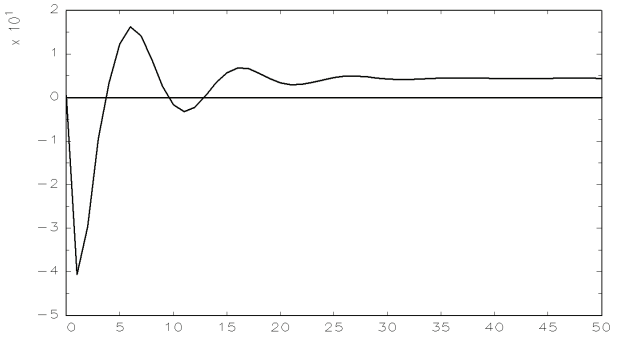

Figure 5: Response of Construction Permit to a Shock on House Prices

According the estimation results of long run impact matrix in the previous section, it is attained that the interest rate shock has a negative effect on the construction permit in the long run. Figure 6 displays how the construction permit is influenced by the shock on interest rate. The response of the interest rate shock fluctuates at the very high levels in the short run, and fluctuations remain in the middle run. Here we can say that the response of suppliers or construction market to an increase in the interest rate is unstable until the long run equilibrium. The interest rate shock also has an impact on the house prices and as it can be seen in the long run impact matrix, it is negative. So, this impact may explain the response of construction permit to the shock on the interest rate, in the long run. The effect of interest rate shock on the supply side quantity attains the permanent level with a negative impact after 30 periods.

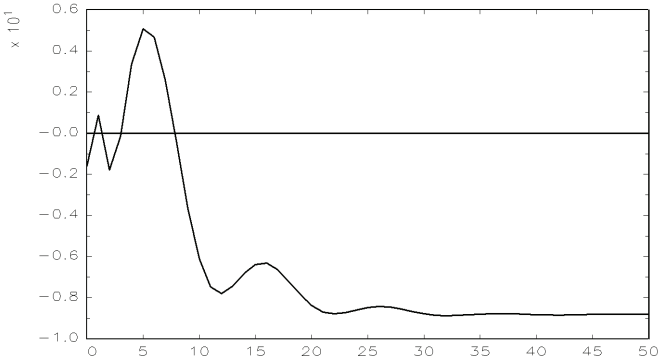

Figure 6: Response of Construction Permit to a Shock on Interest Rate

Next step is to examine how a shock on the construction cost index affects the construction permit. When we look the Figure 7, it can be seen that initially the shock on the construction cost index leads to an increase in construction permit for a very short run. This can happen due to misunderstanding of the construction market. Only one period later, the effect turns out to be negative. Eventually, the effect of the construction cost shock reaches the permanent level after 20 periods. Therefore, one standard deviation shock on the construction cost index induces to a decrease in construction permit level in the long run. That is, increase in cost decreases the quantity supplied if every other things are constant.

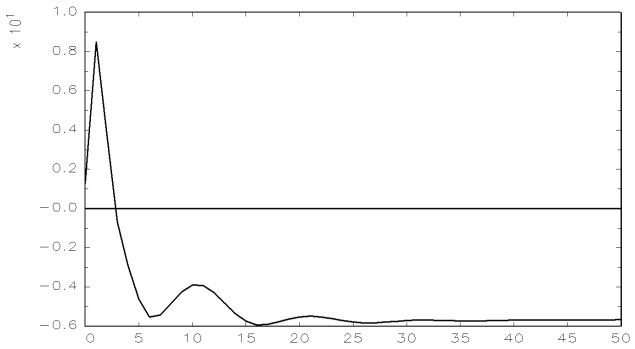

Figure 7: Response of Construction Permit to a Shock on Construction Cost

3.4.2 Forecast Variance Decomposition

One of the implications of structural vector error correction model is variance decompositions. The forecast variance decompositions are summarized in Table 6. Here, we skip some horizons due to small changes in them and report 1st, 5th, 20th and 50th horizons as benchmark time measures. It is noted that there is no an observable difference between the factors that explain forecast error in the house prices and interest rate. However, the forecast error variance of both construction permit and GDP per capita are caused by the shocks on the several variables in the short run, but are dominated by the shocks on themselves in the long run. Additionally, forecast error in the construction cost is accounted for by both of interest rate and GDP per capita in the short run, but the shock on the interest rate is almost only determinant of the forecast error variance of construction cost in the long run. Finally, the permit shock is the main source of the forecast

error variability in the mortgage credit volume in the short run, but GDP per capita shock is the main determinant of the forecast error variability in the mortgage credit volume in the long run. So, we claim that while the forecast error variance in the credit market is explained best by the construction permit in the short run, income per capita has considerable power in the long run for explaining the forecast error variance in the mortgage credit volume. That is, the variability in housing demand in the long run can be widely explained by the income.

4. Conclusion

The main purpose of this paper is to analyze the housing market from both demand and supply sides. Even if there are some studies related to this topic, this study stands out in the sense that we use the appropriate data instead of proxies. The methods to analyze the market are cointegration analysis and vector error correction model. Furthermore, we employ impulse responses and variance decomposition after VECM to analyze the behavior of the market more clearly. According to the analysis, we obtain four main results.

1. We use mortgage credit volume as demand side, and acquire the long-run relation among house prices, GDP per capita and interest rate. On the other hand, when we examine supply side, we find construction permit has long-run relation with house prices interest rate, GDP per capita.

2. In terms of the significant loading factors in the VECM, we conclude that there exist adjustments of mortgage credit volume and construction permit to disequilibrium of housing supply market and adjustment of construction permit to disequilibrium of housing demand market.

3. According to the impulse response analysis, we conclude that the housing market in Turkey is sensitive to the shocks in the economy.

4. In accordance with the variance decomposition, we find that GDP per capita plays the most important role in explaining the mortgage credit volume in the long term.

As a further discussion of the analysis of determinants of house prices would be relevant.

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Appendix

Table 2: Unit Root Test Results (ADF) (H_0: Nonstationary)

Variable	Deterministic terms	lags	test value	%1	%5	%10
cr	constant,trend	4	-2.85	-3.96	-3.41	-3.13
cr	Constant	6	-3.07	-3.43	-2.86	-2.57
per	None	5	0.13	-2.56	-1.94	-1.62
per	None	10	-7.26	-2.56	-1.94	-1.62
hp	constant,trend	10	-2.02	-3.96	-3.41	-3.13
hp	None	0	-2.12	-2.56	-1.94	-1.62
int	constant,trend	2	-0.89	-3.96	-3.41	-3.13
int	None	2	-3.29	-2.56	-1.94	-1.62
cc	constant,trend	10	-2.72	-3.96	-3.41	-3.13
cc	None	0	-4.12	-2.56	-1.96	-1.62
gdppc	constant,trend	1	-3.06	-3.96	-3.41	-3.13
gdppc	None	0	-2.77	-2.56	-1.94	-1.62

Table 3: Unit Root Test Results (KPSS) (H_0: Stationary)

Variable	Deterministic value	lags	test value	%1	%5	%10
cr	None	2	1.49	0:74	0:46	0:35
cr	None	2	0:10	0:74	0:46	0:35
per	None	2	0:76	0:74	0:46	0:35
per	None	2	0:03	0:74	0:46	0:35
hp	None	2	0:53	0:74	0:46	0:35
hp	None	2	0:90	0:74	0:46	0:35
int	None	2	1:30	0:74	0:46	0:35
int	None	2	0:16	0:74	0:46	0:35
cc	None	2	1:49	0:74	0:46	0:35
cc	None	2	0:10	0:74	0:46	0:35
gdppc	None	2	1:82	0:74	0:46	0:35
gdppc	None	2	0:19	0:74	0:46	0:35

Table 4: Johansen Cointegration Test Results

H0	test	10pct	5pct	1pct
r<=5	5.91	10.68	12.45	16.22
r<=4	21.09	23.32	25.73	30.67
r<=3	40.56	39.73	42.77	48.87
r<=2	68.07	60.00	63.66	70.91
r<=1	102.66	84.27	88.55	96.97
r=0	146.42	112.54	117.45	127.04

Table 5: Diagnostic Tests

	Test statistics	p - value
LM test for autocorrelation	83.84	0.16
Jarque - Bera test(ε_{rt})	1.07	0.59
Jarque - Bera test (ε_{pert})	8.22	0.02
ARCH - LM test	903.74	0.30

Table 6: Structural VECM Forecast Error Variance Decomposition

Proportions of		accounted for by					
Forecast error in	Horizon	Δcr	Δper	Δhp	Δint	Δcc	Δgdppc
Δcr	1	0.19	0.37	0.12	0.26	0.02	0.04
	5	0.08	0.16	0.11	0.46	0.02	0.17
	20	0.01	0.01	0.07	0.48	0.01	0.42
	50	0.00	0.00	0.06	0.38	0.00	0.55
Δper	1	0.36	0.34	0.02	0.17	0.11	0.00
	5	0.31	0.61	0.05	0.00	0.00	0.03
	20	0.31	0.60	0.05	0.01	0.01	0.03
	50	0.29	0.57	0.05	0.04	0.02	0.03
Δhp	1	0.00	0.00	0.06	0.81	0.11	0.02
	5	0.00	0.00	0.06	0.81	0.11	0.02
	20	0.00	0.00	0.06	0.81	0.11	0.02
	50	0.00	0.00	0.06	0.81	0.11	0.02
Δint	1	0.53	0.19	0.18	0.02	0.08	0.01
	5	0.53	0.19	0.18	0.02	0.08	0.01
	20	0.53	0.19	0.18	0.02	0.08	0.01
	50	0.53	0.19	0.18	0.02	0.08	0.01
Δcc	1	0.00	0.00	0.00	0.51	0.09	0.40
	5	0.01	0.02	0.00	0.69	0.05	0.23
	20	0.00	0.00	0.00	0.94	0.01	0.05
	50	0.00	0.00	0.00	0.93	0.01	0.05
Δgdppc	1	0.31	0.60	0.04	0.00	0.00	0.04
	5	0.31	0.60	0.04	0.00	0.00	0.05
	20	0.26	0.50	0.03	0.02	0.02	0.17
	50	0.15	0.29	0.02	0.04	0.05	0.45