EVALUATION OF PANEL DATA MODELS AND AN APPLICATION ON ISE30

PANEL VERİ MODELLERİNİN İNCELENMESİ VE BİST30 ÜZERİNE BİR UYGULAMA

EDA SELİN ILIKKAN

PROF. DR. HÜSEYİN TATLIDİL

Supervisor

Submitted to

Graduate School of Science and Engineering of Hacettepe University

as a Partial Fullfilment to the Requirements

for be Award of the Degree of Master of Science

in Statistics.

2019

This work named **"Evaluation of Panel Data Models And An Application On ISE30"** by **EDA SELİN ILIKKAN** has been approved as a thesis for the Degree of **MASTER OF SCIENCE IN STATISTICS** by the below mentioned Examining Committee Members.

Assoc. Prof. Dr. Bülent ALTUNKAYNAK

Head ....

Prof. Dr. Hüseyin TATLIDİL

Supervisor ....

Prof. Dr. Cem KADILAR

Member ....

Assoc. Prof. Dr. Rukiye DAĞALP

Member ....

Assoc. Prof. Dr. Duygu İÇEN

Member ....

This thesis has been approved as a thesis for the Degree of **MASTER OF SCIENCE IN STATISTICS** by Board of Directors of the Institute for Graduate School of Science and Engineering on ...... / ..... /.......

Prof. Dr. Menemşe GÜMÜŞDERELİOĞLU
Director of the Institute of
Graduate School of Science and Engineering

ETHICS

In this thesis study, prepared in accordance with the spelling rules of Institute for Graduate School of Scıence and Engineering of Hacettepe University,

I declare that

- all the information and documents have been obtained in the base of the academic rules
- all audio-visual and written information and results have been presented according to the rules of scientific ethics
- in case of using others Works, related studies have been cited in accordance with the scientific standards
- all cited studies have been fully referenced
- I did not do any distortion in the data set
- and any part of this thesis has not been presented as another thesis study at this or any other university.

12 / 06 /2019

EDA SELİN ILIKKAN

YAYINLANMA FİKRİ MÜLKİYET HAKLARI BEYANI

Enstitü tarafından onaylanan lisansüstü tezimin/raporumun tamamını veya herhangi bir kısmını, basılı (kağıt) ve elektronik formatta arşivleme ve aşağıda verilen koşullarla kullanıma açma iznini Hacettepe Üniversitesine verdiğimi bildiririm. Bu izinle Üniversiteye verilen kullanım hakları dışındaki tüm fikri mülkiyet haklarım bende kalacak, tezimin tamamının ya da bir bölümünün gelecekteki çalışmalarda (makale, kitap, lisans ve patent vb.) kullanım hakları bana ait olacaktır.

Tezin kendi orijinal çalışmam olduğunu, başkalarının haklarını ihlal etmediğimi ve tezimin tek yetkili sahibi olduğumu beyan ve taahhüt ederim. Tezimde yer alan telif hakkı bulunan ve sahiplerinden yazılı izin alınarak kullanması zorunlu metinlerin yazılı izin alarak kullandığımı ve istenildiğinde suretlerini üniversiteye teslim etmeyi taahhüt ederim.

Yükseköğretim Kurulu tarafından yayınlanan "***Lisansüstü Tezlerin Elektronik Ortamda Toplanması, Düzenlenmesi ve Erişime Açılmasına İlişkin Yönerge***" kapsamında tezim aşağıda belirtilen koşullar haricince YÖK Ulusal Tez Merkezi / H. Ü. Kütüphaneleri Açık Erişim Sisteminde erişime açılır.

- ☐ Enstitü / Fakülte yönetim kurulu kararı ile tezimin erişime açılması mezuniyet tarihimden itibaren 2 yıl ertelenmiştir.

- ☐ Enstitü / Fakülte yönetim kurulu gerekçeli kararı ile tezimin erişime açılması mezuniyet tarihimden itibaren .... ay ertelenmiştir.

- ☐ Tezim ile ilgili gizlilik kararı verilmiştir.

12 / 06 / 2019

EDA SELİN ILIKKAN

ABSTRACT

EVALUATION OF PANEL DATA MODELS AND AN APPLICATION ON ISE30

EDA SELİN ILIKKAN

Master of Science, Department of Statistics

Supervisor: Prof. Dr. Hüseyin TATLIDİL

June 2019, 77 pages

Panel data is the intersection of time series and cross-section data. The panel data defines change between units or the change in time for each unit, explains these variabilities by some other variables and estimates each unit in terms of the relevant variables. The purpose of this study is to give information about the models to be done when panel data is obtained and to show this on a specific application. There are commonly known four panel data models, they are the pooled regression model, the most commonly estimated models are probably fixed effects and random effects models and in more complex data sets, a mixed effect model. There are several factors to make choice among panel data models which are pooled regression, fixed effects, random effects, and mixed effects model. In this study, it is aimed to investigate the situation of the ISE30 (Istanbul Stock Exchange-30) in the period 2015-2019 by establishing a panel data regression model consisting of the returns on the stock market shares and the variables affecting these returns. As a result of the study, the model of 37 variables has established and a model when the ones that could not be calculated with the ones missing from the annual 115 financial indicators in the Matriks data program which is a platform about the financial sector, were excluded. Firstly, 5 explanatory variables were determined by stepwise regression from 37 explanatory variables. The relationship between these five explanatory variables and return was investigated by panel data models. The most suitable model was selected by paired comparisons with various tests and the pooled regression model was selected. In all of these models, the rate of explaining the return response variable of within 5 explanatory variables is around 64-74%. As a result; it can be said that stocks, such as the Chande Momentum Oscillator (CMO), Swing Index, Momentum (MOM), Price Earnings Ratio (PER) and Stochastic Fast, affect of the return in the stock exchange as opposed to the popular indicators.

Keywords: Panel Data, Mixed-Effect Model, Panel Cointegration, Autocorrelation, Stata

ÖZET

PANEL VERİ MODELLERİNİN İNCELENMESİ VE BİST30 ÜZERİNE BİR UYGULAMA

EDA SELİN ILIKKAN

Yüksek Lisans, İstatistik Bölümü
Tez Danışmanı: Prof. Dr. Hüseyin TATLIDİL
Haziran 2019, 77 sayfa

Panel verileri, zaman serileri ve kesit serilerinin kesişimidir. Panel verileri, birimler arasındaki değişimi veya her bir birimin zamanındaki değişimi tanımlar, bu değişkenlikleri başka değişkenler tarafından açıklar ve her bir birimi ilgili değişkenler açısından tahmin eder. Bu çalışmanın amacı, panel veri tipine sahip olunduğunda kullanılabilecek modeller hakkında bilgi vermek ve bunu özgün bir uygulama üzerinde göstermektir. Yaygın olarak bilinen dört panel veri modeli vardır. Bu modeller, havuzlanmış regresyon modeli, sabit etkiler ve rastgele etki modelleri ve karışık etki modelleridir. Havuzlanmış regresyon panel veri modelleri, sabit etkiler, rasgele etkiler ve karışık etki modeli arasında tercih yapmak için çeşitli testler geliştirilmiştir. Bu çalışmada, İMKB 30'un (İstanbul Menkul Kıymetler Borsası-30) 2015-2019 döneminde durumunu borsa paylarındaki getirilerden ve bu getirileri etkileyen değişkenlerden oluşan bir panel regresyon modeli oluşturarak araştırmak amaçlanmıştır. Çalışma sonucunda, 37 değişkenli model, Matrix veri programındaki (finansal sektörle ilgili veri platformudur) yıllık 115 finansal göstergeden eksik olanlarla hesaplanamayanların hariç tutulduğu bir model oluşturmuştur. İlk olarak, 37 bağımsız değişkenden adımsal regresyon ile 5 bağımsız değişken belirlenmiştir. Bu beş bağımsız değişken ve getiri arasındaki ilişki panel veri modelleri ile incelenmiştir. En uygun model çeşitli testler ile karşılaştırılarak seçilmiş ve havuzlanmış regresyon modelinde karar kılınmıştır. Bu modellerin hepsinde, 5 açıklayıcı değişkenin hisselere ait getiriyi açıklama oranı

% 64-74 civarındadır. Sonuç olarak, borsadaki bilinen göstergeler dışında sık kullanılmayan göstergelerden, Swing Endeksi, MOM (Momentum), CMO (Chande'nın Momentum Osilatörü), PER(Fiyat Kazanç Oranı) ve Stokastik gibi göstergelerin getiriyi etkilediği görülmüştür.

Anahtar Kelimeler: Panel Veri, Karışık Etki Modeli, Panel Eşbütünleşme, Otokorelasyon, Stata

ACKNOWLEDGEMENTS

I would like to thank Mr.Prof.Dr Hüseyin TATLIDİL, who is my advisor professor who did not neglect his interest and support from me at every stage of my thesis and all the professors of Hacettepe University for which I have benefited from their knowledges during my graduate studies.

Also, I thank my family who have always been with me at this process. My sincere wishes, thank you all my friends who are encouraged and support me at this thesis study process.

CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

CMO	Chande's Momentum Oscillator
ISE	Istanbul Stock Exchange
K5	Stochastic Fast
LM	Lagrange Multiplier
LR	Likelihood Ratio
MLE	Maximum Likelihood Estimator
MOM	Momentum
OLS	Ordinary Least Square
PER	Price Earnings Ratio
RRSS	Restricted Residual Sums of Squares
URSS	Unrestricted Residual Sums of Squares
VAR	Vector Autoregressive Model

1. INTRODUCTION

In the age of technology, everything happening in our lives forms a data set. The data or data set is a net information as numerical values and numbers with universal meanings. In this regard, statistical analysis has become a prominent way in transforming the data into information and making a prediction out of obtained information. The behaviour of data is a mathematical idealization constructed in a statistical model.

Data research is the first pace in data analysis. Besides, it usually contains summarizing the basic features of a data set. [1]. Paces in the data analysis process are collecting data, summarizing and displaying data, analyzing data and interpreting results. Data research provides clues about the suitable model. The important point here is that the data should be compatible with the model to obtain reliable results. Data research also informs researcher about uncommon observations or issues [2]. In short, using the appropriate analysis method based on the data type gives us more reliable results.

In many science areas, you can confront data types, such as cross-section data, time series, or panel data. Cross-sectional data are formed from observations that intensify at one point. Cross-sectional data analysis compares the differences among the subjects. The variables obtained with the data formed according to chronological order are called time series. The most general meaning of time series is a subject measurements at successive equally spaced points in time. In other words, it can be said that unlike cross-sectional data, with time series data subjects are observed over time. In contrast to time series data, many topics have been observed with cross-sectional data.

Panel data is the intersection of time series and cross-section series. Values for any given are the section size of the panel; the values that units receive over the years represent the time dimension. With the use of panel data, the bias caused by unobserved individual differences is reduced to the lowest level. The panel data defines change between units or the change in time of each unit, explains these variabilities by some other variables and estimates each unit in terms of the relevant variables. In other words, the panel data is also known as longitudinal data in literature. As Cheng Hsiao mentions in his book, panel data set is one that follows a given sample of individuals over time, and thus provides multiple observations on each individual in the sample. Panel data have become widely available in both the developed and developing countries [3]. The appeal of panel data models is provided by well-organized panel data. Because these models provide ways of coping with heterogeneity. In addition, these models also analyze fixed and random effect models at the longitudinal dataset. Furthermore, in recent years panel data analyses have closely associated with multivariate and regression analyses especially in econometrics dataset and modeling.

The main aims of this thesis summarizes commonly used data search techniques related to the panel data analysis and compares panel data models. Firstly, it will be mentioned about panel data historical development in chapter 2. The panel data models which assumptions are necessary will be mentioned in chapter 3. Also, necessary tests will be given for model selection. In the fourth chapter, the application will be done. And the effects of the companies traded on the stock exchange Istanbul on the basis of financial indicators will be examined. Information on these financial indicators and analysis results will be given. In addition, it will be given the output of the analysis. Finally, in the fifth chapter, the results will be mentioned.

2. LITERATURE REVIEW

2.1. Historical Panel Data

Panel data is not long as time series and time is not taken into account in the cross-section data. It can be said that depending on the status of the data, the panel data has emerged due to necessity. Panel data can also be a requirement. Therefore, panel data type and related methods play a substantial share within the literature. Pooled cross-sectional time series and longitudinal data are reported as panel data in the literature. Pooled cross-sectional data is mostly used in social sciences and longitudinal data is used in natural sciences [2].

As Edward W. Frees mentioned in his book in 2004, panel work was used in a marketing study in which Lazarsfeld and Fiske investigated the effects of radio advertising on goods sells in 1938 [2]. The longitudinal data and method on child developments and psychology were used by Baltes and Nesselroade in 1979 [4]. They identified longitudinal survey as compose of "a variety of methods connected by the idea that the entity under investigation is observed repeatedly as it exists and evolves over time." Moreover, they traced the need for longitudinal research to at least as early as the nineteenth century. Dielman adopted the approach in which the cross-sectional data were combined [5]. He used time series methods to estimate the regression parameter in this approach. It is in 1989 that the predictions, which are known precisely, are discussed in more detail and given examples. Early applications in the economics of the basic fixed effects model include Kuh in 1959 [6], Johnson in 1960 [7], Mundlak in 1961 [8] and Hoch in 1962 [9], Balestra and Nerlove in 1966 [10] and Wallace and Hussain in 1969 [11] introduced the (random effects) error components model, the model with α_i as random variables. Wishart in 1938 [12], Rao in 1959 [13] and 1965 [14], Potthoff and Roy in 1964 [15] were among the first contributions in the biometrics literature to use multivariate analysis for analyzing growth curves. Specifically, they considered the problem of fitting polynomial growth curves of serial measurements from a group of subjects. The growth curves approach to analyzing longitudinal data was extended by Grizzle and Allen in 1969 [16], who introduced covariates, or explanatory variables, into the analysis. Laird and Ware in 1982 [17] made the other important transition from multivariate analysis to regression modelling. They introduced the two-stage model that allows for both fixed and random effects [2]. In studies where more than two dimensions are available, researchers have conducted studies on how to set up models with 3 or more than 3 dimensions. The work of Matyas in 1997 [18] is one of the best examples of this situation.

Matyas has started to work on multi-dimensional panel data models. Later, more intensive studies were started on panel data analysis. As can be seen in the next section, panel data analysis has a long history.

National panel data sets are created with the developments in panel data analysis. There are several well-known examples of panel data sets are; The Panel Study of Income Dynamics (PSID), Survey of Income and Program Participation (SIPP), The German Socio-Economic Panel (GESOEP), National Longitudinal Survey of Youth (NLSY), The Netherlands Socio-Economic Panel (SEP), The Luxembourg's Social Economic Panel (PSELL), The British Household Panel Survey (BHPS), The Swiss Household Panel (SHP), The Russian Longitudinal Monitoring Survey (RLMS) [19].

2.2. Recent Studies

Frühwirth S. and Schnatter S. in their work "Panel Data Analysis: A Survey On Model-Based Clustering of Time Series" in 2011, in the panel data series, there are extended clusters of time series. Recent reports have proposed approaches to model-based clustering of panel data based on finite mixture models. Also, Bayesian estimation using the Markov Chain Monte Carlo method is explained within the study. In addition, various criteria have also been reviewed to choose the number of clusters. An application to a panel of marijuana used among teenagers serves as an illustration [20].

In the study of Lee L. and Yu J. "Estimation of Fixed Effects Panel Regression Models with Separable and Nonseparable Space-Time Filter" in 2014, the semi-maximum likelihood prediction is taken into account when there are dynamic and spatial correlations in which the failures can be spatially stable or unstable. Likewise, semi-maximum likelihood estimation is also considered within the linear panel data model with individual fixed influences. Throughout their article, they have considered the effect of the first observations and therefore have concluded a definite probability function for prediction [21].

In the study of Balazsi L., Matyas L., and Wansbeek T., "The Estimation of Multidimensional Fixed Effects Panel Data Models" in 2015, they mentioned about three-dimensional fixed effects panel data model. Then, these models are also generalized for multidimensional panel datasets [22].

Multidimensional fixed effects model is a model developed in case of having more than two units and a time dimension by exited of two-dimensional fixed effect panel data model. It is estimated just like the estimation of the two-dimensional fixed-effect panel data models.

In the study of Born B. and Breitung J. “Testing for Serial Correlation in Fixed-Effects Panel Data Models” in 2016, they recommend a range of tests for serial correlation in fixed-effect models in time series smaller than long-time units. They found that Lagrange Multiplier statistics had outstanding features by examining the local power of the tests. Additionally, a generalization is suggested to test the autocorrelations to a certain lag sequence. And against heteroscedasticity, they recommended a robust test statistic that connected to time [23].

In the study of Zhao S., Liu R., and Shang Z. "Statistical Inference on Panel Data Models: A Kernel Ridge Regression Method" in 2017, on account of data with an interactive fixed-effect model, they mentioned about the methods of statistical implication within the framework of the ridge regression model. Compared to conventional selection methods, their methods are automatic in that they do not need the selection of basic functions and truncation parameters [24].

Frees E.'s book published in 2004, “Longitudinal and Panel Data: Analysis and Applications for the Social Sciences”, one of the aims of this book is to acquaint the methodology enhanced in statistical and biological sciences, especially in social sciences [2]. This book describes the topic including regression and linear model theories using relatively complex quantitative tools.

Greene W.’s book “Econometric Analysis” published in 2010, in chapter eleven he mentioned about models for panel data [25]. Fixed and random effect models have also been handled in the applications of discrete and restricted response variable models in the field of micro-econometrics.

In 2015, Tuna and Karaca's work titled “The Estimation of The Increase of Capital of Industry Companies Registered In Borsa Istanbul (ISE(Istanbul Stock Exchange)30)” in the selected year intervals related to the firms traded at ISE30, significant 5 ratios affecting the capital increase of firms using 14 explanatory variables were found by panel data analysis [26].

In 2011, in Karaca and Başçı's work titled “The Ratios Affecting Stock Performance and Panel Data Analysis In ISE30 Index During 2001-2009” using the panel data analysis for the period 2001-2009 in the ISE30 index, net profit margin, operating profit margin, turnover rate of assets and turnover ratio of equity capital have been statistically significant [27].

3. PANEL DATA

The number of N units and the values of these units at time T create panel data when taken together. In other words, values for any given are the section size of the panel; the values that units receive over the years represent the time dimension. Panel data is a multidimensional data type since it contains information of time series and cross-section data. Therefore, it has been preferred in all fields for years. When panel data models are examined, many panel data algorithms such as linear, dynamic, non-linear, qualitative, spatial, etc. are encountered.

Any factor that affects the research may be unknown, unobserved, or unobtainable. With the use of panel data, the bias caused by unobserved individual differences is reduced to the lowest level. The overall representation of the panel data equation is

$$y_{it} = \alpha_{it} + \beta_1 x_{it,1} + \beta_2 x_{it,2} + \ldots + \beta_P x_{it,p} + \mu_{it} \quad (1)$$

In equation (1) i denotes households, individuals, firms, countries, etc. and t denotes time [28]. i=1,…,N; t=1,…,T and p=1,…,P is number of explanatory variables. y_{it}: response variable value of observation i. at the moment t., α_{it}: individual special effect that acts on the response variable and in other words it is a constant term observation i., at the moment t., β_p: slope parameter of explanatory variables. $x_{it,\ p}$: The variable pth at the time tth of the ith observation value of the explanatory variable. The error term, μ_{it}, states the effect of the omitted variable that is special to each unit and time zone. Additional variables, which are either unimportant or unobservable, contain the "error term".

The mean of the error term is zero and its variance is considered constant. They are shown in $E(\mu_{it}) = 0$ and $Var(\mu_{it}) = \sigma^2_{\mu it}$. The slope coefficients shown as β_P are unknown response coefficients. These may vary for different units and time periods. However, when estimating the model, various assumptions are made about the constant term, slope coefficients and error term of the model.

a) Slope coefficients are constant and the intercept varies over individuals:

$$y_{it} = \alpha_i^* + \beta_1 x_{it,1} + \beta_2 x_{it,2} + \ldots + \beta_P x_{it,p} + \mu_{it} \quad (2)$$

i=1,…,N; t=1,…,T and p=1,…,P

b) Slope coefficients are constant and the intercept varies over individuals and time:

$$y_{it} = \alpha^*_{it} + \beta_{1i}\, x_{it,1} + \beta_{2i}\, x_{it,2} + \ldots + \beta_{Pi}\, x_{it,p} + \mu_{it} \quad (3)$$

$$i=1,\ldots,N;\ t=1,\ldots,T \text{ and } p=1,\ldots,P$$

c) All coefficients vary over individuals:

$$y_{it} = \alpha^*_{i} + \beta_{1i}\, x_{it,1} + \beta_{2i}\, x_{it,2} + \ldots + \beta_{Pi}\, x_{it,p} + \mu_{it} \quad (4)$$

$$i=1,\ldots,N;\ t=1,\ldots,T \text{ and } p=1,\ldots,P$$

d) All coefficients vary over time and individuals:

$$y_{it} = \alpha^*_{it} + \beta_{1it}\, x_{it,1} + \beta_{2it}\, x_{it,2} + \ldots + \beta_{Pit}\, x_{it,p} + \mu_{it} \quad (5)$$

$$i=1,\ldots,N;\ t=1,\ldots,T \text{ and } p=1,\ldots,P$$

Panel data models can be created according to the exchangeable of the coefficients. That is, it can classify models by assuming that the coefficients are random or constant [3].

In panel data analysis, there are three types of variable which are type explanatory variables, time-invariant, time-varying and individual time-varying. The time-invariant variable means the value of the variable that does not vary across time. These variables have the same effect on time. For example, gender and race. The time-varying variable means the values of which also vary across individuals. For example, prices, interest rates and so on. Cross-sectional variables at a given time are the individual time-varying variables [3]. In other words, it means that it changes from unit to unit at a given point in time. Firm profits, sales, and capital stock are given as examples for this type of variable.

The assumptions, it makes about α_{it}, which changes not against time but against individuals, help to determine what kind of panel model it should estimate. Also, the situation of N and T values are taken into consideration when this classify is made. So, this situation can consist of following forms;

i. If T is large and N is small, then the fixed model is preferred.

ii. If N is large and T is small, the fixed effect model is preferred if the cross-sectional units do not come from a very large population, and the random effect model is preferred if it comes.

iii. The fixed effect model can be preferred since the estimators of the fixed effect model will be unbiased if N is large T is small and there is a relation between α_{it} and explanatory variables.

iv. If N is large and T is small, then the estimates of the random-effect models are more effective than those of the fixed-effect models if the assumptions of the random effect model are valid.

v. Time-invariant variables which have not been measured can affect y. The fixed effects method controls for time-invariant variables that have not been measured but that affect y. If there is no knowledge about race in the data set, the influence of the race can be controlled. However, in time-invariant variables which measured or unmeasured, the effects of the variables can be controlled but not estimated. That is, it cannot predict the variable that has changed over time for the model [29].

vi. To be able to predict what is known as fixed effects, μ_{it} should be associated with the time-varying explanatory variables [29].

vii. If μ_{it} is not associated with the explanatory variables, (because time-invariant variables are not neglected or neglected variables are not associated with variables in the model) in that case a random-effects model can ensure impartial predicts of the β_p. Also, according to the fixed-effect model, random effect models will usually possess lower standard errors [29].

viii. When working with a two-stage or cluster-based sample, a random effect model should be used.

ix. In case selecting issues based on exterior features put forwards in the stratified sample, the fixed effects model should be used.

If individual effects are not available, it means no cross-sectional or time-specific effects. In the circumstances, the pooled averaged model is preferred, because normal (ordinary) least squares (OLS) will produce an influential and coherent parameter predicts. Furthermore, generally predicted models are likely fixed-effects and random-effects models within panel data analysis. In more complex data sets, a mixed effect model is preferred, such as a multilevel dataset.

3.1. The Pooled Regression Model

The linear regression model can be given as

$$y_{it} = \alpha + \beta_1 x_{it,1} + \beta_2 x_{it,2} + \ldots + \beta_P x_{it,P} + \mu_{it} \tag{6}$$

In order to examine the relations between the variables, the relations between the response and the explanatory variables are compendium by the regression function in (6) which is linear for α, β_1 ,…, β_P parameters. When performing the applications in which the explanatory variables are not random, the only constraint of the equation (6) is to assume that the variables are taken linearly [2].

Assumption of the linear regression model;

1. $E(y_{it}) = \alpha + \beta_1 x_{it,1} + \beta_2 x_{it,2} + \ldots + \beta_P x_{it,P} + \mu_{it}$ where $E(\mu_{it})=0$
2. $\{ x_{it,1}, \ldots , x_{it,P}\}$ are nonstochastic variables,
3. $Var(y_{it}) = \sigma^2$ and $Var(\mu_{it}) = \sigma^2$,
4. $\{ y_{it} \}$ and $\{ \mu_{it} \}$ are explanatory random variables,
5. $\{ y_{it} \}$ is normally distributed [2].

In the panel data coverage, this is also referred to as the population averaged model, under the assumption that any latent heterogeneity is averaged. In order to make the estimation process with the least squares method, it is necessary to provide assumptions such as zero conditional mean of μ_{it}, homoscedasticity, independence between observations, and strict external of x_{it} [30]. In some sources, it is called the marginal version which emphasizes the supposition that observations are related to subjects. Also, the pooled averaged model is a restricted model which represents a behavioral equation with the identical parameters in the time and between individuals.

3.2. Fixed Effect Models

When conducting a study on the regression model, each variable cannot be measured or observed at all times due to at least one neglected variables will always be. In order to establish more accurate models and to make reliable analyzes, it is important to control the effect of these neglected variables on the model to be used. Williams's notes, if it is controlled for the influence of a variable, it must be explicitly gauged [29]. If it is not measured, it can not be controlled. Some variables which cannot be gauged or gauged inadequately will be in applications. Therefore, these models will probably suffer from variable bias that has been neglected to some degree. With panel data, it is possible to check whether the properties which have not changed over time will be measured. Regardless of the effect of these variables at some point over time, these values will have the same effect at a different point in the same time due to the fact that the values of these variables do not change. It can be done by fixed effects models. If the constant coefficient of the panel data model is considered as a constant, then the model is known as the fixed effect model.

Before examining the fixed effects model, firstly, a cross-sectional model

$$y_{it} = \alpha + \beta_1 x_{it,1} + \beta_2 x_{it,2} + \dots + \beta_P x_{it,p} \tag{7}$$

is considered. Since the explanatory variables associated with the response variable, it does not use the knowledge in the repeated measurements on an issue. After, the first expression used in repeated measurements of knowledge on an issue is

$$y_{it} = \alpha_i + \beta_1 x_{it,1} + \beta_2 x_{it,2} + \dots + \beta_P x_{it,p}\,. \tag{8}$$

The fixed effects model consist of equation (8) and assumptions which $x_{it,p}$ p=1,…,P are nonstochastic variables and y_{it} are explanatory random variables. Equation (7), $\{ \alpha_i \}$, which are the intercept terms in equation (8), is permitted to change by subject, as

$$y_{it} = \alpha_i + \beta_1 x_{it,1} + \beta_2 x_{it,2} + \dots + \beta_P x_{it,p} + \mu_{it}. \tag{9}$$

The error term μ_{it} contains in knowledge about α_i in cross-sectional regression models. The most substantial advantage of longitudinal data models over cross-sectional regression model is the property to allocate the effect of $\{ \alpha_i \}$ from error terms $\{ \mu_{it} \}$ [2].

In equation (9), unlike the basic panel data model, $\{ \alpha_i \}$ are constant. In the same way, i=1,…, N; t=1,…,T and p=1,…,P is number of explanatory variables. y_{it}: response variable value of observation i at the moment t, α_i is an individual special parameter reflecting the influence of unobserved group characteristics observation i., β_P: slope parameter of explanatory variables, $x_{it,p}$: explanatory variable value of observation i at the moment t and for pth variable and μ_{it} are explanatory error terms as $\mu_{it} \sim N(0,\sigma_{\mu}^2)$.

Assumption of the fixed effects model;

1. $E(y_{it}) = \alpha_i + \beta_1 x_{it,1} + \beta_2 x_{it,2} + \ldots + \beta_K x_{it,P} + \mu_{it}$ where $E(\mu_{it})=0$
2. $\{ x_{it,1}, \ldots, x_{it,P} \}$ are nonstochastic variables.
3. $Var(y_{it}) = \sigma^2$ and $Var(\mu_{it}) = \sigma_{\mu}^2$.
4. $\{ y_{it} \}$ and $\{ \mu_{it} \}$ are explanatory random variables.
5. $\{ y_{it} \}$ is normally distributed.

$\{ y_{it} \}$ is the explanatory variable. In addition, serial and simultaneous correlations are not found in the model of basic fixed effects. In this way, it is assumed that there is no specific relationship between subjects and time periods. If the roles of i and t change, it can be considered as follows:

$$y_{it} = \lambda_t + \beta_1 x_{it,1} + \beta_2 x_{it,2} + \ldots + \beta_P x_{it,p} \quad . \tag{10}$$

In (10), there is a parameter called λ_t in time-specific variables that are not dependent on issues. In most longitudinal data applications, the number of subjects, N, exceeds the T, which is essentially the maximum number of time periods. Furthermore, the heterogeneity between subjects often states the rate of variabilities more than heterogeneity between time periods. Thus, it can be started with the "basic" function as

$$E(y_{it}) = \alpha_i + \beta_1 x_{it,1} + \beta_2 x_{it,2} + \ldots + \beta_P x_{it,p} \, . \tag{11}$$

Obvious parameterization of the subject-specific heterogeneity is authorized by (11). The equations of (10) and (11) are based on the assumption of classical one-way analysis of covariance model. Therefore, the model of the basic fixed effects may also be called the one-way fixed effects model. When binary (dummy) variables are used for time dimension, time-specific parameters can be included in population parameters. Thus, it is simple to consider the function [2]

$$E(y_{it}) = \alpha_i + \lambda_t + \beta_1 x_{it,1} + \beta_2 x_{it,2} + \ldots + \beta_P x_{it,p} \, . \tag{12}$$

Equation (12), named the two-way constant effects model, has the assumptions that $\{x_{it,1},.., x_{it,P}\}$ are non-hypothetical variables, and $\{y_{it}\}$ is an explanatory random variable.

The fixed effect model should be preferred if it is thought that some explanatory variables that cannot be included in the model should be included in (12).

3.3. Random Effect Models

Modelling individual fixed terms as randomly distributed across cross-sectional units may be appropriate if individual effects are not fully associated with the variables in the model [30]. In other words, the random effects models are preferred when the terms included in the panel data model are not constant over time and the terms that are considered to describe the characteristics of the observations are not constant. The formulation of the model is

$$y_{it} = \alpha_i + \beta_1 x_{it,1} + \beta_2 x_{it,2} + ... + \beta_P x_{it,p} + \mu_{it} \tag{13}$$

where i=1,…, N; t=1,…,T and p=1,…,P is number of explanatory variables. y_{it}: response variable value of observation i at the moment t, α_i is a random variable representing the effect of units special characteristics observation i, β_P: It is a slope parameter of explanatory variables, $x_{it,p}$: explanatory variable value of observation i at the moment t and for pth variable and μ_{it} are explanatory error terms.

Assumptions of the random effects model,

1. $E(y_{it} \mid \alpha_i) = \alpha_i + \beta_1 x_{it,1} + \beta_2 x_{it,2} + ... + \beta_P x_{it,p}$.
2. $\{ x_{it,1}, ... , x_{it,P} \}$ are nonstochastic variables.
3. $Var(y_{it} \mid \alpha_i) = \sigma^2$.
4. $\{ y_{it} \}$ are explanatory random variables, conditional on $\{ \alpha_1, …, \alpha_n \}$.
5. $\{ y_{it} \}$ are normally distributed, conditional on $\{\alpha_1, …, \alpha_n\}$.
6. $E(\alpha_i) = 0$, $Var(\alpha_i) = \sigma_\alpha^2$ and $\{ \alpha_1, …, \alpha_n \}$ are mutually explanatory.
7. $\{ \alpha_i \}$ is normally distributed.

Assumptions 1, 3 and 5 show the similarity to the assumptions of the fixed effects model. Being in random subject-specific terms $\{ \alpha_1, \ldots, \alpha_n \}$ is the essential difference here. The sampling basis of the special terms is summarized by the 6th and 7th assumptions. Taken together, these assumptions constitute the model of error components [2].

These assumptions do not provide an "observables" representation of the model due to they are based on unobservable quantities, $\{ \alpha_1, \ldots, \alpha_n \}$. To summarize the effects of Assumptions 1-7 on the observable variables, $\{ x_{it,1}, \ldots, x_{it,P}, y_{it} \}$; some differences are as follows: $Var(y_{it}) = \sigma^2 + \sigma_\alpha^2$ and $Cov(y_{ir}, y_{is}) = \sigma_\alpha^2$, for $r \neq s$, $\{ y_{it} \}$ are explanatory normally distributed random vectors.

This formulation of the model (13) is similar as the error demonstration of the basic fixed effects model. In addition to this, it is presumed that the α_i is a random variable, not a constant, unknown parameter. The term α_i is known as a random effect [2]. In addition, x_{it} is a vector of covariates or explicatory variables. And β is a fixed vector in population parameters in the random effect model that is not yet known. It is inevitable to add a constant into the x_{it} vector due to $E(\alpha_i) = 0$.

The effect of known variables which may affect the response is measured by linear combinations of $x_{it}' \beta$ form. Additional variables that are insignificant or unobservable include the "error term." [2]. For this reason, α_i and μ_{it} are two error terms, one at the level of integrity and the other at the singular level. The error terms assign their distributions to them as usual specifically most particularly it is assumed that identically and independently distributed with mean zero and variance σ_μ^2 [31]. Besides α_i is assumed to be the identically and independently distributed by mean zero and variance σ_α^2. Moreover, the α_i is explanatory of the error random variable, μ_{it}. In addition, this model is known in the literature as the error component model.

According to Rodriguez [31], if the model rewrites by joining the two error terms in one:

$$y_{it} = \beta_1 x_{it,1} + \beta_2 x_{it,2} + \ldots + \beta_P x_{it,p} + \varepsilon_{it} \tag{14}$$

where $\varepsilon_{it} = \mu_{it} + \alpha_i$. The equation (14) is similar to the known traditional regression model, however, the difference is that errors are not independent. Rather, they are independent across groups but not within a subgroup because the ε_{it}'s for members of group i share α_i [31]. Another word, to define the model parameters, it assumes that these error terms are independent. In addition, α_i reflects the time-invariable part and ε_{it} reflects the remaining part. According to Frees's book [2], the models of error components are also referred in the literature as a random intercept models. These identifiers are used since the α_i intersection is a random variable.

The correlation between any two observations can be written in the same group

$$\rho = Cor(Y_{ij}, Y_{ij'}) = \frac{\gamma_\alpha}{\sigma_\alpha^2 + \sigma_\mu^2} \tag{15}$$

as a result that follows directly from the usual definition of correlation; the covariance between Y_{ij} and $Y_{ij'}$ is γ_α and the variance of either is $\sigma_\alpha^2 + \sigma_\mu^2$. These coefficients are generally named intra-class correlation coefficients. The variance of the observations consists of two constituent. These models are named variance constituent models in the literature. The γ_α states to the alteration between groups, while the σ_μ^2 states to the alteration in groups. Supposing that the OLS prediction was used in the equation model (13), coherence predictions for the regression coefficient β would be attained. Predictions cannot give accurate results as they do not account for covariance. Unless straightened for grouping, the values of standard errors will be prejudiced [31].

The coefficient related to the time-invariant variable is estimated within the random effects model. Therefore, if a time-invariant variable like race in studies which are spread over time, the random effect model should be preferred.

3.4. Mixed Effect Models

It consists of two methodologies at panel data commonly used in the experimental literature. These are random and fixed effect models in the panel data. Mixed effect models are the extended state of the known fixed effect model. At the same time, it also contains both the fixed and random effect models. In other words, it can be said that equation (13) contains random and fixed effects. The error components models are a particular case of the mixed linear models. When considered there is a linear relation among explanatory with the response variable, the equation of mixed effect model is

$$Y_{it} = \text{random effect} + \text{fixed effect} + \text{error term}$$

$$Y = Z\alpha + X\beta + \mu. \quad (16)$$

In this general formulation of the mixed effect model (16), the Z expresses random effects parameter estimates, α expresses random effect, X expresses fixed effects and β expresses fixed effects parameter estimates.

There are two different types of Mixed Effect Models that are Linear mixed effects model and Mixed linear models.

3.4.1. Linear mixed effects model

The conditional regression function is

$$E\,(y_{it} \mid \alpha_i) = z_{it}'\,\alpha_i + x_{it}'\,\beta. \quad (17)$$

In this form, the model consists of two portions which are random effect portion and fixed effect portion. The random effect portion is the term $z_{it}'\,\alpha_i$ and the fixed effect portion is the term $x_{it}'\beta$. The short-hand notation (17) is a short version of (18) as

$$E\,(y_{it} \mid \alpha_i) = \alpha_{i1}\, z_{it1} + \ldots + \alpha_{iq}\, z_{itQ} + \beta_1\, x_{it1} + \ldots + \beta_P\, x_{itP}. \quad (18)$$

The fixed effects model have no serial correlation and no heteroscedasticity, but assume that the model of the mixed effects has serial correlation and heteroscedasticity. It maintains the presupposition which the responses among experimental objects are independents.

Assume that the $\{\alpha_i\}$ is independent with mean $E(\alpha_i) = 0$ and $Var(\alpha_i) = D$, D is a variance-covariance matrix and also it is a $q \times q$ positive definite matrix. In the case of random effect models, the average must be expected to be zero. However, if the mean is not zero, fixed effect models could be mentioned. Generally, a subset of the columns of X_i is the columns of Z_i. Taken together, these assumptions comprise what term in the linear mixed effects model [2].

Assumptions of the linear mixed effects model,

1. $E(y_i \mid \alpha_i) = Z_i\, \alpha_i + X_i\, \beta$.
2. $\{x_{it,1}, \ldots, x_{it,P}\}$ and $\{z_{it,1}, \ldots, z_{it,Q}\}$ are nonstochastic variables.
3. $Var(y_i \mid \alpha_i) = R_i$.
4. $\{ y_i \}$ are explanatory random vectors, conditional on $\{\alpha_1, \ldots, \alpha_n\}$.
5. $\{ y_i \}$ are normally distributed, conditional on $\{ \alpha_1, \ldots, \alpha_n \}$.
6. $E(\alpha_i)= 0$, $Var(\alpha_i) = D$ and $\{ \alpha_1, \ldots, \alpha_n \}$ are mutually independent.
7. $\{ \alpha_i\}$ is normally distributed.

When Assumptions 3 and 6 are examined, the variance of each unit is

$$
\begin{aligned}
Var(y_i) &= Z_i\, D\, Z_i' + R_i \\
&= V_i(\tau) \\
&= V_i. \qquad (19)
\end{aligned}
$$

The $V_i(\tau)$ expresses the variance-covariance matrix of $\{y_i\}$. The $V_i(\tau)$ is subject to variance components τ .

It can be analyzed synchronically for both the effect of units special term $\{\alpha_i\}$ and parameters related to the time-invariant variable in the linear mixed effect models.

3.4.2. Mixed linear models

Mixed linear models are also recognized as a generalized linear mixed-effect model. At the same time, the mixed linear effects model can be said to be a private kind of the linear mixed model. $\{y_i\}$ is expressed as an explanatory random vector in a panel dataset. This assumes independence among subjects. However, these suppositions are not acceptable for all models of repetitive observation. The clasic mixed model equation is

$$y = Z\, \alpha + X\, \beta + \mu\ , \qquad (16)$$

where y is a $N \times 1$ vector of responses, μ is a $N \times 1$ vector of errors, Z and X are $N \times Q$ and $N \times P$ matrices of explanatory variables, respectively, and α and β are $Q \times 1$ and $P \times 1$ vectors of parameters [31]. $E(y \mid \alpha) = Z\,\alpha + X\,\beta$ and $E(\alpha) = 0$, so that $E(y) = X\,\beta$. For the covariance structure, $Var(y \mid \alpha) = R$, $Var(\alpha) = D$ and $Cov(\alpha, \mu') = 0$. This yields $Var(y) = Z\,D\,Z' + R = V$.

Linear mixed effect models require independence, while mixed linear models do not require independence. The model is sufficiently flexible. It is useful for complex structures such as hierarchical data sets.

Briefly, mixed linear models are the generalized form of a linear mixed-effect model. In addition, mixed linear models also contain other models used in longitudinal data analysis. Most estimates can be made directly by the mixed linear models. One of the main advantages of linear mixed effect models is the provision of more predictive platforms for longitudinal data [2].

The relation between the response variable and the explanatory variables is explained by the coefficients of one or more group variable in linear mixed effect models. The mixed-effect models comprise of two sections. These are fixed and random effect models. The fixed-effect models are often a section of traditional linear regression. However, the random-effect models are related to individualistic empirical units that are randomly drawn from a population. Although there are priority distributions on the random effect models, this is not the case with the fixed effect models.

The Generalized Linear Mixed Models as linear predictor include usual fixed effects and random effects. However, it is estimated as a one-stage regression model rather than the Expectation Maximization Model.

In addition to this, it can be said that the constant effect, random effect and mixed effect model show the unrestricted model which has the same behavioural equation but has different parameters according to time or individuals.

3.5. Panel Vector Autoregressive Model

The vector autoregressive models, which named VAR in shortly, is a multivariate simultaneous equation system where each variable in the system is regressed on a finite number of lags of all variables jointly considered. An advantageous feature of this method is that it treats all variables in its system as endogenous variables. Thus, it is suitable to adopt this model for observing relationships where one is not sure whether variables are exogenous. Feedback effects between variables are observable since coefficients are obtained for each lagged variable in the system regressed on each variable. Additionally, a VAR allows one to trace of the effect of a shock to variable on another by examination of the impulse response functions. By merging traditional fixed effect regressions with the time series VAR, this method allows the benefits of the VAR described above to be applied to multiple cross-sections. Additionally, a panel VAR eliminates the unit-specific effects which can generate the endogeneity problem of lagged values of the response variable and result in omitted variable bias [32].

3.6. Assumption of Panel Data

As it has been previously mentioned, the panel data analysis is the intersection of the time series and the cross-sectional data. In statistical analysis, the appropriate model should provide certain assumptions. These assumptions are that in a regression model, there are no problems of normality, heteroscedasticity and autocorrelations. The time series should be at the stationary structure in order to make time series analysis. When cross-sectional data analysis is performed, there should be no cross-sectional dependence problem. Thus, in the panel data analysis, it is expected that these assumptions of the appropriate panel data model will be provided. These assumptions are as follows:

3.6.1. Heteroskedasticity Tests

The variation of the error terms in the fixed-acting model from unit to unit reveals the changing variance problem. Wald test statistic is used to test whether this problem exists. In the case of a random effect model, the heteroskedasticity reveals when the variability of variances of one or both of the error terms is demonstrated. In a random-effect model, Levene-Brown and Forsythe tests are used to test this problem.

The hypothesis for this test is

H_0: There is no heteroskedasticity

As in ($H_0 = \sigma_i{}^2 = \sigma^2$), against,

H_1: There is a heteroskedasticity

The modified Wald test statistic is distributed as a χ^2 with the N degree of freedom. The modified Wald test stastistics,

$$W = \sum_{i=1}^{N} \frac{(\hat{\sigma}_i^2 - \sigma)^2}{\text{Vi}}, \tag{20}$$

$$\text{where } v_{it} = \alpha_i + \bar{\mu}_i, \tag{21}$$

$$V_i = \frac{(T_i - 1)}{T_i} \sum_{t=1}^{T_i} (v_{it}^2 - \sigma_i^2)^2, \tag{22}$$

$$\hat{\sigma}_i^2 = \frac{\sum_{t=1}^{T_i} V_{it}^2}{T_i}. \tag{23}$$

In Equation (23), $\hat{\sigma}_i^2$ is the estimator of error variance at ith cross-sectional unit.

The Levene test statistics is

$$W_0 = \frac{\sum_i n_i(\bar{Z}_\iota - \bar{Z})^2/(p-1)}{\sum_i \sum_j (Z_{ij} - \bar{Z})^2 / \sum_i (n_i - 1)}, \tag{24}$$

where $Z_{ij} = |X_{ij} - \bar{X}_\iota|$. In (24), X_{ij} is observed at jth with and ith units; n_i is number of observations and p_i is number of units at i=1,…,P. W_0 is compared with Snedecor F table with (p-1) and $\sum_i (n_i - 1)$ degrees of freedom. And the p-value is small enough (<0,05 level) to reject the null hypothesis. So, it means there is heteroskedasticity.

3.6.2. Autocorelation Test

Autocorrelation is the relationship between the successive values of the error term. In the randomized model, the autocorrelation test is calculated by the Lagrange Multiplier (LM) test, while the Baltagi Wu LBI test is used for the autocorrelation test in both the fixed and random models.

The hypothesis for this test is

H_0: There is no autocorrelation

As in ($H_0 = \rho = 0$), against,

H_1: There is an autocorrelation

The Lagrangre Multiplier test stastistics is

$$\lambda_{LM} = T \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij}^2, \tag{25}$$

where $\hat{\rho}_{ij}^2$ is ith and jth correlation coefficient between units errors. Here, $\hat{\rho}_{ij}$ can be calculated as

$$\hat{\rho}_{ij} = \hat{\rho}_{ji} = \frac{\sum_{t=1}^{T} \hat{v}_{it} \hat{v}_{jt}}{(\sum_{t=1}^{T} \hat{v}_{it}^2)^2 (\sum_{t=1}^{T} \hat{v}_{jt}^2)^2} . \tag{26}$$

The LM test statistics is distributed as a χ^2 with N(N-1)/2 degree of freedom and the p-value is small enough (<0,05 level) to reject the null hypothesis. So, it means there is autocorrelation.

3.6.3. The Cross-Sectional Dependence Test

The cross-sectional dependency can result from common shocks and the existence of unobserved ingredients [33]. When examining the appropriate model, it should be investigated whether there is a cross-sectional dependency. In accordance with Baltagi, long-term time series is a problem in macro panels in cross-sectional dependency tests. However, this does not pose a problem in micro panels consisting of several years and many values [34]. The existence of the cross-sectional dependence of the series is made by the Berusch-Pagan LM test or Pesaran CD test. The Berusch-Pagan LM test is used when the time dimensions are bigger than the cross-sectional dimensions, whereas the Pesaran CD test is used when the time dimensions are smaller than the cross-sectional dimensions.

The hypothesis for this test is

H_0: There is no cross-sectional dependence

against,

H_1: There is a cross-sectional dependence.

The Pesaran test statistics is

$$CD = \sqrt{\frac{2}{N(N-1)}}\,(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\sqrt{T_{ij}\hat{\rho}_{ij}}\ , \tag{27}$$

where $\hat{\rho}_{ij}^2$ is ith and jth correlation coefficient between units errors. The Pesaran test statistics is distributed as a χ^2 with N(N-1)/2 degree of freedom.

The Friedman test statistics is

$$FR = [(T-1)(N-1)R_{AVE} + 1)], \tag{28}$$

where R_{AVE} is average coefficient of Spearman correlation. It is calculated as

$$R_{AVE} = \frac{2}{N(N-1)}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{r}_{ij}, \tag{29}$$

where $\hat{r}_{ij}$ is coefficient of Spearman rank correlation and its calculated as

$$r_{ij} = r_{ji} = \frac{\sum_{t=1}^{T}(\rho_{i,t}-(T+0,5))(\rho_{j,t}-(T+0,5))}{\sum_{t=1}^{T}(\rho_{i,t}-(T+0,5))^2}. \tag{30}$$

The Friedman test statistic is asymptotically distributed as a χ^2 with (T-1) degree of freedom.

Table 1: Cross-Sectional Dependence Tests

Model	Test	Test Statistics	The Distribution
Fixed Effect	Lagrange Multiplier	λ_{LM}= $T\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}^2$	
Random Effect or Fixed Effect	Pesaran CD_{LM}	CD = $\sqrt{\frac{2}{N(N-1)}}$ $(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\sqrt{T_{ij}\hat{\rho}_{ij}}$	χ^2
	Friedman R	FR = $[(T-1)(N-1)R_{AVE}+1)]$	
	Frees Q	FRE = $N(R_{AVE}^2-(T-1)^{-1})$	

Here, the p-value is small enough (<0,05 level) to reject the null hypothesis. So, it means there is a cross-sectional dependence. The summary of cross-sectional dependence tests is given in Table 1.

3.6.4. Unit Root Tests

The dimension of the panel data as well as possess the dimension of the time, in order to determine the process that creates the data, the stationarity of the series should be required to investigate. For this purpose, unit root tests are used. Generally, unit root tests determine is time series are stationary and is contain a unit root. Unit root tests can also be used to determine if trending data should be first differenced or regressed on deterministic functions of time to render the data stationary. There is a large number of tests in the panel data analysis that checks whether there is a unit root. These methods, for example, are collected under a single command in the stata program.

In the panel unit root test field, two generations of tests have been developed. The first type consists of Levin, Lin and Chu test, Im, Pesaran and Shin test, Maddala and Wu test, Choi test and Hadri test. The supposition in these tests is to provide cross-sectional independence between units, whereas the second type of tests refuse the cross-sectional independence hypotheses. This second type of tests consist of two basic approaches. The covariance constraints approaches were accepted by Chang [35], in particular. Another approachment is the factor structure approachment including contributions by Bai and Ng, Phillips and Sul, Moon and Perron, Choi and Pesaran among others [35].

Two generations of panel unit root tests have been developed as shown in Table 2.

Table 2: Panel Unit Root Tests

First Generation	Nonstationarity Tests	Levin and Lin (1992,1993) Levin, Lin and Chu (2002) Im, Pesaran and shin (1997,2003) Maddala and Wu (1999) and Choi (1999,2001)
	Stationarity Tests	Choi's (2001) Hadri (2000)
Second Generation	Factor Structure	Pesaran (2003) Choi (2002) Moon and Perron (2003) Philips and Sul (2003) Bai and Ng (2004)
	Other Approaches	O'Connel (1998) Chang (2003) Breitung and Das (2003)

Therefore, one of the most widely used tests, Choi panel unit root test will be used.

The hypothesis for this test is

H_0: There is unit root

against,

H_1: There is no unit root.

The Choi Test statistics is

$$P = -2\sum_{i=1}^{N} \ln(p_i), \tag{31}$$

where, p_i = F (C_{iTi})($p_i = 1 - F$ (C_{iTi})) is the asymptotic p value defined in (31). Here, the C_{iTi} is the unit root statistics calculated for each i group obtained from the model created for the panel unit root test, and F (*) is the distribution function created for C_{iTi}. The Choi test statistic is asymptotically distributed as a χ^2 with 2N degree of freedom [37]. Here, the p-value is small enough (<0.05 level), then the null hypothesis is rejected.

Before choosing a model, since the mixed effect model includes both the fixed effect and the random effect models, assumptions within these two models will also be assumed to be provided in a mixed effect model.

3.6.5. Panel Cointegration Test

The cointegration test is a technique developed to examine the correlation between two non-stationary time series. Since panel data analysis has a time dimension, panel cointegration tests are used for scrutinizing the long-term correlate between panel series. The Kao panel cointegration test was developed using Dickey Fuller (DF) and Augmented Dickey Fuller (ADF) test structures in 1999. The McCoskey and Kao panel cointegration test was developed using LM test statistics in 1998. The Pedroni panel cointegration test (2000,2004) can be categorized into two groups. To be cointegrated in the time series, the first group uses the average test statistics among the sections. In the second group, the averages are divided into parts according to the first group and the bounding distributions are based on the boundaries of the divided numerator and denominator terms [38].

The hypothesis for this test is

H_0: There is no cointegration in panel series

against,

H_1: There is a cointegration in panel series.

In Table 3, panel cointegration tests are grouped according to the methods they are used and the types of tests on which they are based.

Table 3: Panel Cointegration Tests

Method	**Panel Cointegration Test**	**Test Type**
Residual Based	Kao (1999)	DF and ADF Test
	McCoskey and Kao(1998)	LM Test
Other Methods	Pedroni Test (2000,2004)	
Likelihood-Based	Larsson, Lyhagen and Löthgren (2001)	

3.7. Tests for Model Selection

The general aim of panel data analysis is to detect unnoticed heterogeneity. And it is also to evaluate and estimate it. The methods improved to this aim are based on certain supposition. These are based on the error term, regression, and regression model coefficients [39]. For this purpose, there are several factors for the prefer between panel data model types which consist of fixed, random and mixed effect model. When combining fixed vs. random effects, group vs. time effects, and one-way vs. two-way effects, six possible panel data models are included as shown in Table 4. The one-way model is usually handled basically by virtue of their parsimony. Furthermore, the fixed effects model is apprehensible generally than the random effects model to predict and comment on the model [40]. In this section, the tests used to select between panel data models will be discussed.

Table 4: Classification of Panel Data Analysis

	Type	**Fixed Effect**	**Random Effect**
One Way	Group	One-way fixed group effect	One-way random group effect
	Time	One-way fixed time effect	One-way random time effect
Two-Way	Mixed	Two-way fixed time and random group effect	
		Two-way fixed group and random time effect	

3.7.1. Breusch and Pagan Test

The Lagrange Multiplier (LM) test was developed by Breusch-Pagan in 1980 to test whether the random two-way error component model was suitable. This test based on the ordinary least square residuals to determine whether random effect exist [40]. The basic task is to estimate the unobserved heterogeneity. The distribution of α_i is parameterized in the random effect model. According to the study of Hübler, parameterization of α_i makes the random effect model completely parametric [40]. BALESTRA and NERLOVE untied the parametric problem first [10].

The hypothesis for this test is

H_0: Pooled regression model

As in ($H_0 : \sigma^2_{\mu} = \sigma^2_{\lambda} = 0.$) against,

H_1: Random effect model

LM is asymptotically distributed as a χ^2 with P degree of freedom [38]. Here, the p-value is small enough (<0,05 level) to reject the null hypothesis. So, there is a significant random effect model preferred than the Pooled regression model. Breusch and Pagan Lagrange multiplier test statistics is

$$LM = \frac{N\,T}{2\,(T-1)}\left[\frac{\sum_{i=1}^{N}(\sum_{t=1}^{T}\mu_{it})^2}{\sum_{i=1}^{N}\sum_{t=1}^{T}\mu_{it}^2} - 1\right], \tag{32}$$

where μ_{it} is an error term in models of pooled regression and random effect model, N is unit size and T represents time size.

3.7.2. Hausman Test

Hausman developed the Hausman test in 1978 to compare the estimates of the fixed and the random effect model. The null hypothesis is that the preferred model is random effects; the alternative hypothesis is that the model is fixed effects. The fixed effects model and the random effects model respectively have the same general panel data model form [41]:

$$y_{it} = \alpha_i + \beta_1 x_{it,1} + \beta_2 x_{it,2} + \ldots + \beta_P x_{it,p} + \mu_{it} \tag{33}$$

as in Equations (9) and (13). The main difference between these two types of models is only in the estimation methods and looking at the individual-specific component $\boldsymbol{\alpha}$. The α represents the effect of unobserved group characteristics in the fixed effect model. Also it represents the effect of units in the random effect model. The hypothesis for this test is

H_0: $Cov\ (\alpha_i, \boldsymbol{x_{it}}) = 0$

against,

H_1: $Cov\ (\alpha_i, \boldsymbol{x_{it}}) \neq 0$.

The Hausman test statistic is distributed as a χ^2 with p which is the number size of parameter degree of freedom. Here, the p-value is small enough (<0,05 level) to reject the null hypothesis. Then, there is a significant fixed effect model preferred than the random effect model. Hausman test statistics is

$$H = (\hat{\beta}_{FE} - \hat{\beta}_{RE})' \, [\, Var\left(\hat{\beta}_{FE}\right) - Var\left(\hat{\beta}_{RE}\right)]^{-1} (\hat{\beta}_{FE} - \hat{\beta}_{RE}), \qquad (34)$$

where $\hat{\beta}_{FE}$ is estimator of fixed effect model and $\hat{\beta}_{RE}$ is estimator of random effect model. Var $\left(\hat{\beta}_{FE}\right)$ is the covariance matrix from obtaining fixed effect model estimator and Var $\left(\hat{\beta}_{RE}\right)$ is the covariance matrix from obtaining random effect model estimator.

3.7.3. Wald Test

The Wald test, developed by Abraham Wald, computes a test statistic based on the unrestricted regression [42]. It is used to decide between the pooled regression model and the fixed effect model. One advantage of the Wald test is that a large sample chi-square statistic can still be obtained on the basis of estimators that do not use the optimal weighing matrices. The Hausman test is obtained as a Wald test based on a particular specification of the alternative hypothesis [43].

The hypothesis for this test is

H_0: Pooled regression model

against,

H_1: Fixed effect model

The Wald test is asymptotically distributed as a χ^2 with P and NT degrees of freedom. Here, the p-value is small enough (<0,05 level) to reject the null hypothesis. Then, there is a significant fixed effect model preferred than the Pooled regression model. The wald test statistics is

$$W = (R\hat{\beta} - r)' \, (R\hat{V}R')' \, (R\hat{\beta} - r), \qquad (35)$$

where $\hat{V}$ is matrix of variance; R is matrix of correlation and r is the correlation coefficient.

3.7.4. Chow Test

Gregory Chow developed the Chow test in 1960. Chow Test, which is one of the structural change tests, is one of the most common applications of the F test [30]. One could test of these models by performing an F-test the joint significance, i.e. $H_0: \mu_1 = \mu_2 = \cdot \cdot \cdot = \mu_{N-1} = 0$. This is a simple Chow test with the restricted residual sums of squares (RRSS) being that of ordinary least squares (OLS) on the pooled regression model and the unrestricted residual sums of squares (URSS) being that of the least squares dummy variables regression. N must be large in order to be able to perform the internal conversion and use the sum of the remaining squares as URSS [38].

The hypothesis for this test is

H_0: Pooled regression model

As in. ($H_0; \mu_1 = \mu_2 = \cdot\cdot\cdot = \mu_{N-1} = 0.$) against,

H_1: Fixed effect model.

The chow test is asymptotically distributed as F with N-1 and N(T-1)-K degrees of freedom. The p-value is small enough (<0,05 level) to reject the null hypothesis. So, there is a significant fixed effect models preferred than the Pooled regression models. The Chow test statistics is

$$F = \frac{(RRSS-URSS)/(N+T-2)}{\frac{URSS}{(N-1)(T-1)-K}}, \qquad (36)$$

where K is number of explanatory variables.

3.7.5. F Test

ANOVA F-test, which is important for fixed effects, was detected by Moulton and Randolph in 1989, who performed well for the unidirectional error component model [38].

The hypothesis for this test is

H_0: Pooled regression model

As in ($H_0; \mu_1 = \mu_2 = \cdot\cdot\cdot = \mu_{N-1} = 0.$) against,

H_1: Fixed effect model.

In order to test null H_0 hypothesis, F distribution with (N-1) and NT-N-K degrees of freedom is used. The F test is

$$F = \frac{(RRSS - URSS)/(N-1)}{\frac{URSS}{NT-N-K}}, \qquad (37)$$

where RRSS is the restricted residual sums of squares; URSS is the unrestricted residual sums of squares and K is number of explanatory variables. The p-value is small enough (<0,05 level) to reject the null hypothesis. Then, there is a significant fixed effect model preferred than the Pooled regression model.

3.7.6. Likelihood Ratio Test

While calculating the likelihood ratio test statistics, the random effects model and the classical model are estimated by the maximum likelihood method and the log-likelihood values obtained from both are used. The one-sided likelihood ratio (LR) test is

$$LR = -2 \log \frac{l(res)}{l(unres)}, \qquad (38)$$

where l(res) denotes the restricted maximum likelihood value (under the null hypothesis), while l(unres) denotes the unrestricted maximum likelihood value. The LR tests require MLE estimators of the one-way and the two-way models and are comparatively more expensive than their LM counterparts. Hypothesis are

H_0: Pooled regression model

against,

H_1: Mixed effect model.

Under the null hypotheses considered, the LR test statistics have the same asymptotic distributions as their LM counterparts [38]. The LR test statistic is distributed as a χ^2 with q degress of freedom. The q is number of restrictions. Under the null hypotheses the p-value is small enough (<0.05 level) to reject the null hypothesis. Then, there is a significant mixed effect model preferred than the Pooled regression model.

Table 5: Summary of Model Selection Tests

Hypothesis	**Test**
H_o: Pooled Regression H_1: Random Effect	Lagrange Multiplier
H_o: Pooled Regression H_1: Fixed Effect	Chow, F, Wald
H_o: Random Effect H_1: Fixed Effect	Hausman
H_o: Pooled Regression H_1: Mixed Effect	Likelihood Ratio

Model selection tests are given in Table 5.

4. APPLICATION

This section of the study provides information about the method and data of the study after focusing on the scope and purpose of the study. The variables in the study are explained.

The aim of this study is to investigate the situation of the ISE30 in the period 2015-2019 by establishing a panel data regression model consisting of the returns on the stock market shares and the variables affecting these returns. The data used in the study were obtained from the Matriks data program which is a platform about the financial sector. These data were also analyzed by Stata 14 package programs.

ISE, which was first named as the Istanbul Stock Exchange in 1985 and named as Borsa Istanbul after 2013, provides safekeeping and swap services to domestic and foreign origin banks and brokerage houses operating in capital markets. The ISE30 index is a platform created by measuring the common performance of the stocks of the top 30 companies traded on the Borsa Istanbul with the highest market capitalization. There are also other index types including ISE50 and ISE100. The companies in ISE 30 are given in Appendix 1.

In a portfolio analysis, especially when buying and selling stocks, there are variables to be considered. These are included in the literature as financial indicators.

4.1. The Finance Indicators

Financial indicators or indicators in short are mathematical calculations. These mathematical calculations allow investors to estimate their future price by evaluating the past performance of the investment tool that they are interested in.

There are 115 indicators in Matriks Data Program from financial indicators in the stock market system in Turkey. Generally, the indicators mentioned below are frequently preferred by investors. These can also be called popular indicators. Information about the indicators, which is known commonly and also used by everyone who is not expert in the stock market as used herd psychology, is listed in the following subsections:

4.1.1. Commodity Channel Index (CCI)

The Commodity Channel Index, which is known as CCI in short, is actually developed by D. Lambert for commodity markets and is also a suitable indicator for stock markets. In the most basic sense, it is tried to find out how far the prices deviate from the statistical average.

The CCI compares the current price with the average price over a period of time. The indicator is moved into positive or negative zone based on swinging above or beneath zero. While many of values, approximately 75%, descend between -100 and +100, about 25% of the values fall outside this range, pointing to a lot of feebleness or robustness in the price movement [44].

4.1.2. Moving Average (MA)

A Moving Average, that is MA, in brief, is a commonly used indicator in technical analysis that assists smooth out price action by filtering out the "noise" from unsystematic price fluctuations. It is a trend-following or lagging, an indicator as it is based upon preceding prices [45]. The Moving Average studies define the milestones of general trends and reduce the impact of short term fluctuations. The Moving Average can be split into four main types as simple, weighted, exponential, triangular. It is used to identify upwards and downwards trends. Seek for price moves above or beneath the Moving Average to point out when you may desire buy or sell.

4.1.3. Moving Average Convergence Divergence (MACD)

The Moving Average Convergence Divergence, which is know as MACD in brief, was enhanced by Gerald Appel in the 1970s. This indicator is a trend-following momentum pointer which indicates the relationship between two moving averages of a security's price [46]. The MACD tries to give information about the direction of the trend by evaluating the short-term exponential average according to the position of the long-term exponential average.

A Positive MACD value is contemplated bullish and a negative value is contemplated bearish. MACD is interpreted in the same way as MA. MACD is widely used in technical analysis due to its positive results in trading. MACD, which is the difference between the two exponential moving averages that are generally used on 26 and 12 days, tries to give information about the direction of the trend by evaluating the positions of the short term exponential average according to the long term. When performing MACD calculation, this indicator changes to The Moving Average Convergence Divergence with moving average if classic moving average is used instead of exponential moving average. In short, it can be shown as MACD-MA. MACD-MA will also be taken over as an indicator in its own right.

4.1.4. Momentum (MOM)

The Momentum indicator, which is known as MOM in short, makes a comparison between the present price and the former price from a selected number of epoch ago [47]. The momentum indicator is usually used in technical analysis because it shows the movement of the price change and the amount and intensity in a given period of time. Momentum is an indication of how the prices move and in what quantity and intensity in a certain amount of the time. The main goal of the momentum is to find out where the current closure is as the period value relative to the previous closing. Momentum vary depending on the year that interested in and the strategies that apply. The Momentum generally yields more positive results in short term periods. Generally, the indicator is used in collaboration with other signals.

4.1.5. Swing Index

The Swing Index is a technical indicator. It was developed by Welles Wilder to attempt to predict future short-term price action. It gives a numerical value that is between +100 and -100. [48] When the Swing Index is in the range of -100 to 0, an investor can expect short-term price movements to rise. And when the Swing Index is in the range of 0 to +100, an investor can expect short-term price movements to move downwards.

4.1.6. Ichimoku Kinko Hyo (ICH-KH)

The Ichimoku Kinko Hyo, which is known as Ichimoku or ICH-KH in brief, is a technical pointer that is used to measure momentum along with following areas of support and resistance. The all-in-one technical indicator is one of which comprises of five lines called the tenkan-sen, kijun-sen, senkou span A, senkou span B and chickou span.

The Ichimoku Kinko Hyo indicator was originally developed by a Japanese newspaper writer to combine various technical strategies into a single indicator that could be easily implemented and interpreted. In Japanese, "Ichimoku" translates to "one look" senses traders only have to take one look at the chart to determine momentum, support, and resistance [49].

The Ichimoku Kinko Hyo indicator is used in long-term periods, including daily and weekly. This indicator is used to measure many aspects of the market. The Ichimoku Kinko Hyo indicator shows similarities with MA in terms of calculation.

4.1.7. Senkou Span B

One of the five main components used in the ICH-KH indicator is the Senkou Span B. The Senkou Span B is generally regarded as the slowest moving component of the ICH-KH indicator because it is created by using the greatest number of time periods in its calculation [50].

4.1.8. Senkou Span A

The Senkou Span A is a line used to measure momentum and provide for signals showing support and resistance levels [51]. It works together with the Senkou Span B. It is also one of the five main components used in the ICH-KH indicator as the Senkou Span B.

4.1.9. Kijun Sen

The Kijun Sen is the centre between the highest high and lowest low of a security over a defined period of time and is used in the making of the ICH-KH indicator. It is one of the two moving average lines displayed on the chart, and is a 26-period moving average [52].

4.1.10. Tenkan Sen

The Tenkan Sen gives a moving average of the highest and lowest prices of a security over the past nine periods. The Tenkan Sen shows a security's short-term price momentum and, when read against a longer-term momentum indicator, yields a prediction of future price movement [53].

4.1.11. Kairi Relative Index (KRI)

The Kairi Relative Index, which is used as KRI in short, is an old Japanese metric. The Kairi Relative Index indicator informs the investor about the direction and speed of the movement by associating the value of a share with its moving average. This indicator consists of data and period values. The default values for these indicators are closing and 14. In case the positive difference between the last price level of the share and the moving average of this share, the prices will indicate to be on an upward trend. In addition, the speed will also be increased. On the other hand, if the difference between the last price level of the share and the moving average of this share is negative, the prices will indicate to be on a downward trend. Accordingly, the speed of decline will also increase [54].

4.1.12. Relative Strength Index (RSI)

Relative Strength Index, which is used as RSI in short, developed by J. Welles Wilder in 1978. It seeks to find the days of rising of the stock according to the previous day and the falling days of the previous day and compare them with each other and make predictions in this way [55]. This indicator consists of data and period values. The default values for these indicators are closing and 14. The extension of the maturities in terms of RSI will bring about the problem of unresponsiveness to price movements. This indicator is usually used for reference values of 30 and 70. It is stated that the RSI values fall below the general acceptance 30 reference value indicate over-sale, while the RSI values are exceeding 70 indicate that it is over-purchase.

4.1.13. Stochastic RSI (S-RSI)

The Stochastic RSI, which is known as S-RSI in short. It was found by Tushard Chande in 1994. The RSI indicator is generated by the application of a Stochastic indicator. This indicator consists of data, period values, and K%. The default values for these indicators are closing, 14 and 7. The use of S-RSI gives investors information about how much of the present RSI value is bought and sold. Over 50 indicates the received signal, and below 50 indicates the sale signal.

While calculating the S-RSI indicator, as mentioned above in MACD-MA, it is named Stochastic Relative Strength Index with Moving Average (S-RSI-MA) when moving average is used. Just like the MACD-MA, it will be considered as a separate indicator in the S-RSI-MA. Its interpretation is similar to the S-RSI.

4.1.14. Chande's Momentum Oscillator (CMO)

Chande Momentum Oscillator, which is CMO in short, is an indicator of the direction how prices move in a certain period of the time. In this indicator was found by Tushar Cande, the range width is between -100 and 100. In the CMO indicator, the default values for period and data sections are 9 and closing values. The CMO gives information to the investors about the upward and downward direction of prices. If it is greater than 0, prices are indicated to be in an upward trend. Likewise, if it is lower than 0, prices are indicated to be in a downward trend. There are also two separate reference lines with -50 and 50. It shows that the prices will decrease in the over 50, while in case of those below -50, the prices will rise.

4.1.15. Volume Oscillator (VLO)

A volume oscillator, which is VLO in short, calculates volume by gauging the relation across two moving averages. VLO calculates the moving average of the values with fast and slow volume. The VLO calculates the quick and slow volumes moving averages [56]. It shows how much stock is bought and sold within a certain period in the market. It is used in the interpretation and confirmation of price movements. As the increase in the transaction volume, which declined sharply towards the end of the fall, may indicate that the recovery started; The transaction volume, which started to decrease towards the end of the rise, may also be a sign of loosening.

4.1.16. Williams Percent Range (W%R)

The Williams Percent Range, which is W%R in short, was found by Larry Williams. W% R is a short-term and leading indicator such as the stochastic. This indicator consists of the period. The default value for this indicator is 14. W% R is a short-term indicator. This indicator is usually used for reference values of 0 and 100. This indicator gauges overbuy and oversold levels. The indicator is very similar to the Stochastic oscillator and is used in the same way [57]. Another use of W% R is to look at the price discrepancies. It is possible to speak of a discrepancy as long as the reflections of the bottom and hills do not match.

4.1.17. Price Earnings Ratio (PER)

The price-earnings ratios which are PER, in short, obtained by dividing the marketing values per shares by the earnings per shares. If this ratio is low, it can be said that it is ideal for investment. In order to calculate the P/E ratio indicates how much the investors costs for a company's profit. When selecting P/E ratio, market averages are utilized. It is also used to compare the prices of shares.

4.1.18. Directional Indicators (+DI/-DI)

The Directional Movement, developed by J.W.Wilder, explores the direction in which the prices tend to move. Directional Movement is the basic point of directional indicators. The Directional indicator has 2 separate lines with positive and negative. This indicator consists of period values. The default values for this indicator is 14. It gives information to the investor about determining the trend. The calculation of this indicator is relatively easy compared to other indicators. If the direction of movement is upward, the value will be positive and if the direction of movement is downward, the direction will be negative. Then the sum of them is divided by the difference of them, so DX value is obtained. This indicator is used for reference values of 0 and 100. The direction of movements is not important for DX. If DX obtains the value zero, it indicates that there is no trend and a stable market. Although DX does not give any information about the direction, the current trend is to arise and the price movements will accelerate. In cases where the DX is rising and indicates the existence of a trend, the high of the DI+ will be on an upward trend, while the high of the DI- indicates a downward trend [58].

4.1.19. Stochastic Fast

Stochastic Fast is an indicator developed by George C. Lane. The stochastic fast used in the evaluation of the price according to its distance from the highest and lowest levels in the period consists of 2 separate lines. The stochastic fast requires the K% and D% parameters, and the default values for these indicators are 5 and 3. Fast Stochastic is obtained by calculating the average of the last three K%. When the current closing value of the period is subtracted from the closing value at the lowest day of the period, the percentage of the result obtained by dividing the highest value of the period by the difference of the lowest value is called K%.

4.1.20. Stochastic Slow

The Slow Stochastic Oscillator is an indication of the closing position between the lowest and the highest values within a certain time period and consists of two separate lines. The Slow Stochastic Oscillator requires K%, D% and Slow K% parameters, while the default values for these indicators are 5, 3 and 3, respectively. This indicator takes values from 0 to 100. The main difference between the stochastic indicators is Slow K%. Firstly, D% is obtained by taking the moving average of K%. D% is considered to be a Slow K% value and a 3-day moving average is calculated. Thus, the stochastic slow indicator is obtained.

D% is obtained by taking the moving average of K%. The fast stochastic is more sensitive than the slow stochastic to changes in the price.

4.2. The Results

Popular indicators were mentioned. Portfolio analysis is not only limited to these. 115 indicators situated in the matrix data program are given in Appendix 2. However, since some of these 115 indicator values cannot be calculated on an annual basis or as an indicator which is not stated in our country, it is calculated zero. Since the zero values in the data set will affect the results of the analysis in a wrong way, these indicators are not included in the analysis. The list of indicators participating in the analysis is given in Appendix 3.

In the study to be carried out on an annual basis, the data related to the stocks of 30 companies in ISE30, based for the last 5 years, are handled. However, Enerjisa Enerji AS (ENJSA), which has not been included in ISE30 for the last 5 years and Emlak Konut Gayrimenkul Yatırım Ortaklığı AS(EKGYO), which is missing in most of its data, is not included in the study. In this case, a data set consisting of 28 units and 5 years will be used.

Annual returns were calculated on the closing data of stocks. According to closing data, the percentage increase of the shares compared to the previous year was calculated and be addressed as a return. The return information belonging to the shares is given in Table 6:

Table 6: General Situation of Shares

ISE30	2015	2016	2017	2018	2019
AKBNK	-0,21	0,19	0,29	-0,27	0,12
ARCLK	-0,04	0,55	0,04	-0,24	0,16
ASELS	0,42	0,51	1,51	-0,24	-0,09
BIMAS	0,04	-0,03	0,63	0,14	-0,06
DOHOL	-0,25	0,33	0,14	0,17	0,15
EKGYO	-0,03	0,19	-0,06	-0,42	0,00
EREGL	-0,26	0,81	1,09	-0,23	0,34
FROTO	-0,04	0,07	1,08	-0,12	0,08
GARAN	-0,23	0,09	0,45	-0,23	0,13
HALKB	-0,24	-0,08	0,17	-0,33	-0,09
ISCTR	-0,30	0,17	0,40	-0,32	0,30
KCHOL	-0,10	0,29	0,37	-0,21	0,24
KOZAA	-0,27	0,77	2,01	0,12	-0,19
KOZAL	-0,18	0,33	1,34	0,34	-0,15
KRDMR	-0,43	0,06	1,79	-0,32	0,14
PETKM	0,16	0,31	1,28	-0,25	-0,07
SAHOL	-0,18	0,12	0,24	-0,30	0,13
SISE	0,00	0,34	0,38	0,25	0,04
SODA	0,32	0,54	0,19	0,64	0,02
TAVHL	-0,01	-0,18	0,67	0,11	0,20
TCELL	-0,20	-0,02	0,76	-0,15	0,05
TEKFEN	-0,29	0,64	1,73	0,26	0,18
THYAO	-0,23	-0,32	2,13	0,03	-0,10
TOASO	0,26	0,34	0,38	-0,46	0,25
TTKOM	-0,19	0,01	0,22	-0,39	0,15
TUPRS	0,26	0,11	0,85	0,08	0,29
VAKBN	-0,21	0,15	0,57	-0,42	0,16
YKBNK	-0,31	0,04	0,27	-0,43	0,38

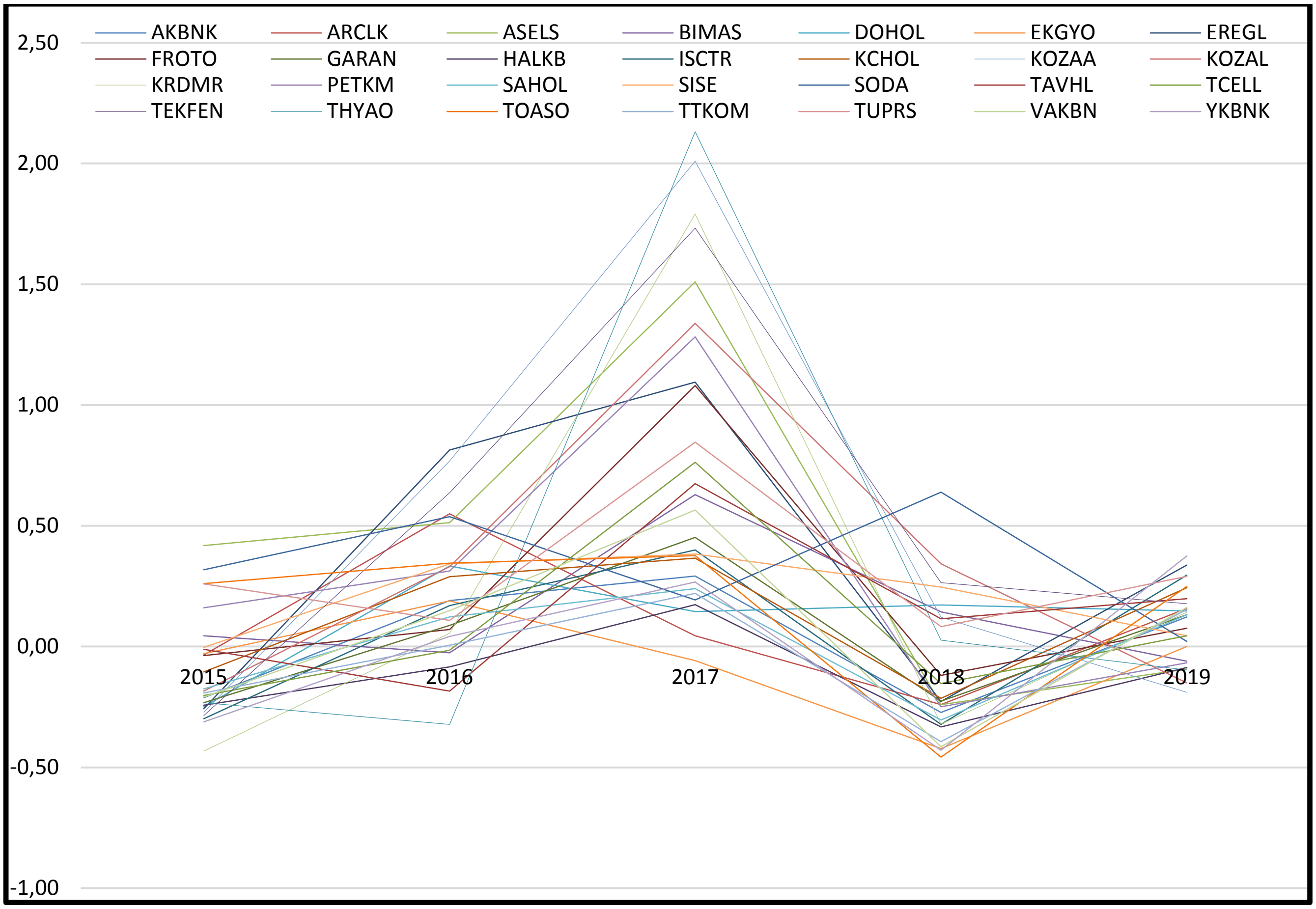

Figure 1: General Situation of Shares

Figure 1 shows that, in general, ISE30 shares experienced a positive increase in 2017, it can be said that this increase in the following periods has turned into a decline. Political fluctuations, foreign relations and domestic politics influence an important part of the movements in the stock market.

By keeping the unit and time constant, the correlation between the return and the indicators is as shown in Table 7.

Table 7: Correlation Matrix Between Return and the Indicators

Indicators	Correlation	P-Value	Indicators	Correlation	P-Value
A/D	0,07	0,412	MOM	0,446	0,00
ASwing	0,131	0,123	NVI	0,071	0,403
CO	0,201	0,014	OBV	0,099	0,247

Table 7: Continues

Indicators	Correlation	P-Value	Indicators	Correlation	P-Value
CHO(3,10)	0,136	0,109	PD	0,060	0,483
CMO	0,363	0,000	PD/DD	0,211	0,012
DKB	0,027	0,755	PVI	0,132	0,119
DKK	-0,114	0,18	TILL(3)	0,081	0,343
DOSB	0,029	0,737	TSF(3)	0,108	0,204
PER	0,420	0,000	WCL	0,105	0,216
Open	-0,020	0,815	ZigZag(%5)	0,111	0,192
High	0,099	0,245	Swing	0,732	0,000
Low	0,004	0,966	K5	0,600	0,000
Close	0,061	0,477	%D(3)	0,321	0,000
MAV(5)	0,029	0,733	%K(5,5)	0,187	0,027
MAV(5)	0,029	0,733	%D(3)	0,123	0,000
MSL(% 5)	-0,047	0,582	TVI(50)	0,038	0,656
PAR	-0,030	0,725	VPT	0,027	0,750
PSAR	-0,042	0,625	Will A/D	0,122	0,151
SAR	0,140	0,099			

When the relation between return and indicators is examined, it can be said that there is a high correlation between the Swing index and the return with 0.73 and between the return and Stochastic Fast (K5) with 0.60, also correlation between the Momentum index (MOM) and the return with 0.45 and between the Price Earning Ratio (PER) and the return with 0.42 and a low correlation between the Chande's Momentum Oscillator (CMO) and the return 0.36 as seen in the correlation matrix. In this case, The Swing Index, The Stochastic Fast value, The Momentum Index, the PER with Chande's Momentum Oscillator as an independence variable in panel data analysis; the response variable will be handled as the return value of the shares.

At the same time, if it is desired to determine the variables to be entered into the model by stepwise regression, the results of this regression model are as follows.

Table 8: Stepwise Regression Results

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	ANOVA P-Value
(Constant), Swing	0,732	0,536	0,533	0,321	0,000
(Constant), Swing, PER	0,766	0,587	0,580	0,304	0,000
(Constant), Swing, PER, CMO	0,804	0,647	0,639	0,282	0,000
(Constant), Swing, PER, CMO, MOM	0,822	0,676	0,667	0,271	0,000
(Constant), Swing, PER, CMO, MOM,K5	0,831	0,691	0,679	0,266	0,000

As in Table 8, by the result of the stepwise regression analysis is seen that 5 of 37 financial indicators are included in the regression model. It can be said that the rates of explanation of the return of these 5 indicators are in parallel with the correlation analysis. In this case, The Swing Index, The Stochastic Fast(K5) value, The Momentum(MOM) Index, The Price Earnings Ratio (PER) with Chande's Momentum Oscillator (CMO) as an independence variable in panel data analysis; the response variable will be handled as the return value of the shares.

Descriptive statistics for the response variable and explanatory variables are given in Table 9.

Table 9: Descriptive Statistics of Return and the Chosen Indicators

Variables	Mean	Std. Deviation	Min	Max
Return	0,172	0,469	-0,457	2,131
Swing	18,098	48,969	-100	100
Stochastic Fast	59,857	27,183	1,876	100
PER	9,596	9,713	0	80,363
MOM[1]	5,893	1,011	0	9,243
CMO	39,726	34,538	-25,609	100

The results of the panel data models generated by the explanatory variables are obtained to decide the most suitable model as shown in Table 10.

[1] The unit of MOM, which is one of the explanatory variables, is not a proportion value. Therefore, since it is a comparable variable, with this variable which is taken as logarithm has been continued to work.

Table 10: Results of Models

Model	Prob > Chi2	R-Square
Populated Averaged Model	0,00	0,6480
Fixed-Effects (Within) Regression	0,00	0,7546
Between Regression	0,00	0,6968
Random-Effects ML Regression	0,00	
Random-Effects GLS Regression	0,00	0,7423
Mixed-Effect	0,00	

According to the panel data model results, it can be said that 5 models are significant with 95% reliability. The rate of explaining the return response variable of 5 indicators such as The Swing Index, The Stochastic Fast value, The Momentum Index, the PER, Chande's Momentum Oscillator variables is around 64-74%. In order to make an estimate, the most appropriate model should be decided. After the control of the assumptions, the most appropriate model will be decided by comparing the one model to another model. The detailed program outputs are given in Appendix-4.

4.3. Assumption

The model to be used according to the Hausman test statistic will be detected. The result table for the Hausman test is as in Table 11.

Table 11: Result of Hausman Test

Test	Test-Value	P-Value
Hausman Test	9,56	0,0885

According to the Hausman test statistic, the null hypothesis, at 95% confidence level, can not be rejected. This situation shows that the estimation process should be continued with the random effect model. The detailed program output is given in Appendix-5.

According to the Hausman test results, the random effect model was decided. However, by controlling the assumptions of the results of the fixed effect, the results of the fixed effect model will be given, as well.

4.3.1. Heteroskedasticity Test Results

Table 12: Results of Heteroskedasticity

Model	Test	Test-Value	P-Value
Random Effect	Levene Test	$W_{0=10} = 2{,}2539$	0,001
Fixed Effect	Modified Wald Test	$X^2\,(28) = 4419{,}52$	0,000

In the random effect model, since the p-value obtained by the Levene test statistic is smaller than 0,05, it can be said that there is a problem of heteroskedasticity in this model. Similarly, it is seen that there is a problem of heteroskedasticity since the p-value of the modified test statistic for the fixed-acting model is smaller than 0,05. Therefore, in both models, the null hypothesis that the variance of each unit is equal to the panel average cannot be accepted and it is observed that the variance varies according to the units. The detailed program output is given in Appendix-6.

4.3.2. Autocorrelation Test Results

Table 13: Results of Autocorrelation

Model	Test	Test-Value	P-Value
Random Effect	Lagrange Multiplier Test	0,70	0,4033
Fixed Effect	Baltagi-Wu LBI Test	2,37	-

The p-value obtained as a result of the Lagrange Multiplier test, that shows there is no autocorrelation in the error terms for the random effect model, is bigger than 0,05. Therefore, the null hypothesis cannot be rejected. For the fixed effect model, the Baltagi-Wu LBI test statistic, which indicates that there is no autocorrelation in the error terms of the null hypothesis, is calculated as 2,37. Since this statistical value is close to 2, it can be said that there is no autocorrelation problem. The detailed program output is given in Appendix-7.

4.3.3. The Cross-Sectional Dependence Test Results

Table 14: Results of Cross-Sectional Dependence

Model	Test	Test-Value	P-Value
Random Effect	Friedman Test	10,486	0,998
Fixed Effect	Pesaran CD Test	4,678	0,000

According to Friedman test statistics, the null hypothesis cannot be rejected (p > 0,05). It can be said that there is no cross-sectional dependence for the random effect model. Since the probability value obtained as a result of the Pesaran test statistic is less than 0,05, the null hypothesis cannot be accepted strongly and for the fixed effect model, there is a cross-sectional dependence. In this case, there is a cross-sectional dependence between ISE 30 shares forming the panel. Any shock to one of the ISE 30 shares will affect other shares. Therefore, while determining the policy regarding the returns of these shares, the shocks affecting the policies and returns of other shares should also be taken into consideration. The Detailed program output is given in Appendix 8.

4.3.4. The Unit Root Test Results

Table 15: Results of Unit Root Tests

Model	Test	Test-Value	P-Value
Random Effect	Harris–Tzavalis Test	-10,224	0,000
Fixed Effect	Pesaran's CADF Test	16,980	1,000

Since the cross-sectional dependency is not encountered in the random effect model, first-generation unit root tests will be used when deciding on the unit root test. When it is looked at the Harris-Tzavalis test, which is the first generation unit root test, it can be said that the response variable and explanatory variables do not consist of unit roots. In the fixed effect model, second-generation unit root tests will be used when deciding the unit root test when faced with cross-sectional dependence in the model. When it is looked at the Pesaran CD test, which is the second generation unit root test, response variables and explanatory variables can be said to contain unit roots. The Detailed program output is given in Appendix 9.

4.3.5. The Cointegration Test Results

Table 16: Results of CointegrationTests

Test	Test-Value	P-Value
Modified Dickey-Fuller t	1,601	0,054
Dickey-Fuller t	-4,586	0,000
Augmented Dickey-Fuller t	-11,276	0,000
Unadjusted modified Dickey-Fuller t	-1,647	0,049
Unadjusted Dickey-Fuller t	-7,317	0,000

As a result of Kao cointegration test, five statistics were calculated and according to this, the results are given in Table 16. When the result is examined, according to only one of the five statistics, the null hypothesis cannot be rejected. According to the other four statistics; since the p-value is less than 0,05 error margin, the null hypothesis is rejected and it can be said that there is a long-term relationship between variables.

4.3.6. Model Selection Result

Firstly, the random effect model was decided with the Hausman test. Based on the random effect model, and in addition to this, the fixed effect has been given together with the control of the assumptions in relation to the model. However, in terms of evaluated by comparing the models, it is necessary to decide which model to choose with the model selection. The binary comparisons made for this purpose are given in Table 17.

Table 17: Results of Model Selection

Hypothesis	Test	P-Value	Result
H_o: Pooled Regression H_1: Random Effect	Lagrange Multiplier	1,000	Pooled Regression Model
H_o: Pooled Regression H_1: Fixed Effect	Chow	0,692	Pooled Regression Model
H_o: Random Effect H_1: Fixed Effect	Hausman	0,261	Random Effect Model
H_o: Pooled Regression H_1: Mixed Effect	Likelihood Ratio	1,000	Pooled Regression Model

The binary comparisons of panel data models are given in Table 16. When the models are examined, it seems that the random effect model with the pooled regression model can be preferred. However, when these two models are compared because the p-value obtained by the Lagrange multiplier test is bigger than the margin of error, the pooled regression model is preferred. In the continuation of the study, while ISE30 firms are examined, it will be analyzed according to the pooled regression model.

The pooled regression model result in detail is

$$\text{return} = -0{,}447+\underset{(0{,}0006)}{0{,}006(\text{Swing Index})}+\underset{(0{,}0016)}{0{,}005(\text{Stochastic Fast})}+\underset{(0{,}4136)}{0{,}144(\text{MOM})}+\underset{(0{,}0026)}{0{,}012(\text{PER})}-\underset{(0{,}0013)}{0{,}006(\text{CMO})}$$

$$R^2 = 0{,}65,\ F(5,134)=49{,}35,\ \text{Prob}>F = 0{,}0000$$

According to the pooled regression model, response variable return and explanatory variables such as Swing index, Stochastic Fast, Momentum Index, Price Earnings Ratio with Chande's Momentum Oscillator used in the model, were found to be significant. The increase of Swing Index by one per thousand increases the return by 6 units. The increase of Stochastic Fast by one per thousand increases the return by 5 units. The increase of Momentum Index by one per hundred increases the return by 14 units. The increase of Price Earnings Ratio by one per thousand increases the return by 12 units. When Chande's Momentum Oscillator is examined, it is observed that the coefficient is negative. The fact that the coefficient is negative does not mean that it affects the return negatively. The fact that the CMO is negative is an indication of an expected increase in prices. In this case, the increase of CMO by one per hundred, increase the return by 6 unit. Generally, it is explained that the return of shares in ISE30 of 5 indicators such as Swing index, Stochastic Fast, Momentum Index, Price Earnings Ratio with Chande's Momentum Oscillator variables is around 65%. Also, all of the variables were found significant at 0,05 significance level.

The panel regression results of the shares traded on ISE30 by the years are as follows.

Table 18: Stock Models By Years

ISE30	Year	Constant	Time	Stock	Swing	K5	MOM	PER	CMO
ARCLK	2016	-0,447	+0,190	+0,194	+0,006	+0,005	+0,144	+0,012	-0,006
	2017	-0,447	+0,518	+0,194	+0,006	+0,005	+0,144	+0,012	-0,006
	2018	-0,447	+0,086	+0,194	+0,006	+0,005	+0,144	+0,012	-0,006
	2019	-0,447	+0,185	+0,194	+0,006	+0,005	+0,144	+0,012	-0,006
ASELS	2016	-0,447	+0,190	+0,338	+0,006	+0,005	+0,144	+0,012	-0,006
	2017	-0,447	+0,518	+0,338	+0,006	+0,005	+0,144	+0,012	-0,006
	2018	-0,447	+0,086	+0,338	+0,006	+0,005	+0,144	+0,012	-0,006
	2019	-0,447	+0,185	+0,338	+0,006	+0,005	+0,144	+0,012	-0,006
BIMAS	2016	-0,447	+0,190	+0,169	+0,006	+0,005	+0,144	+0,012	-0,006
	2017	-0,447	+0,518	+0,169	+0,006	+0,005	+0,144	+0,012	-0,006
	2018	-0,447	+0,086	+0,169	+0,006	+0,005	+0,144	+0,012	-0,006
	2019	-0,447	+0,185	+0,169	+0,006	+0,005	+0,144	+0,012	-0,006
DOHOL	2016	-0,447	+0,190	+0,067	+0,006	+0,005	+0,144	+0,012	-0,006
	2017	-0,447	+0,518	+0,067	+0,006	+0,005	+0,144	+0,012	-0,006
	2018	-0,447	+0,086	+0,067	+0,006	+0,005	+0,144	+0,012	-0,006
	2019	-0,447	+0,185	+0,067	+0,006	+0,005	+0,144	+0,012	-0,006
EREGL	2016	-0,447	+0,190	+0,353	+0,006	+0,005	+0,144	+0,012	-0,006
	2017	-0,447	+0,518	+0,353	+0,006	+0,005	+0,144	+0,012	-0,006
	2018	-0,447	+0,086	+0,353	+0,006	+0,005	+0,144	+0,012	-0,006
	2019	-0,447	+0,185	+0,353	+0,006	+0,005	+0,144	+0,012	-0,006
FROTO	2016	-0,447	+0,190	+0,332	+0,006	+0,005	+0,144	+0,012	-0,006
	2017	-0,447	+0,518	+0,332	+0,006	+0,005	+0,144	+0,012	-0,006
	2018	-0,447	+0,086	+0,332	+0,006	+0,005	+0,144	+0,012	-0,006
	2019	-0,447	+0,185	+0,332	+0,006	+0,005	+0,144	+0,012	-0,006
GARAN	2016	-0,447	+0,190	+0,016	+0,006	+0,005	+0,144	+0,012	-0,006
	2017	-0,447	+0,518	+0,016	+0,006	+0,005	+0,144	+0,012	-0,006
	2018	-0,447	+0,086	+0,016	+0,006	+0,005	+0,144	+0,012	-0,006
	2019	-0,447	+0,185	+0,016	+0,006	+0,005	+0,144	+0,012	-0,006
ISCTR	2016	-0,447	+0,190	+0,048	+0,006	+0,005	+0,144	+0,012	-0,006
	2017	-0,447	+0,518	+0,048	+0,006	+0,005	+0,144	+0,012	-0,006
	2018	-0,447	+0,086	+0,048	+0,006	+0,005	+0,144	+0,012	-0,006
	2019	-0,447	+0,185	+0,048	+0,006	+0,005	+0,144	+0,012	-0,006
KCHOL	2016	-0,447	+0,190	+0,111	+0,006	+0,005	+0,144	+0,012	-0,006
	2017	-0,447	+0,518	+0,111	+0,006	+0,005	+0,144	+0,012	-0,006
	2018	-0,447	+0,086	+0,111	+0,006	+0,005	+0,144	+0,012	-0,006
	2019	-0,447	+0,185	+0,111	+0,006	+0,005	+0,144	+0,012	-0,006

Table 18: Continue

ISE30	Year	Constant	Time	Stock	Swing	K5	MOM	PER	CMO
KOZAA	2016	-0,447	+0,190	+0,251	+0,006	+0,005	+0,144	+0,012	-0,006
	2017	-0,447	+0,518	+0,251	+0,006	+0,005	+0,144	+0,012	-0,006
	2018	-0,447	+0,086	+0,251	+0,006	+0,005	+0,144	+0,012	-0,006
	2019	-0,447	+0,185	+0,251	+0,006	+0,005	+0,144	+0,012	-0,006
KRDMR	2016	-0,447	+0,190	+0,121	+0,006	+0,005	+0,144	+0,012	-0,006
	2017	-0,447	+0,518	+0,121	+0,006	+0,005	+0,144	+0,012	-0,006
	2018	-0,447	+0,086	+0,121	+0,006	+0,005	+0,144	+0,012	-0,006
	2019	-0,447	+0,185	+0,121	+0,006	+0,005	+0,144	+0,012	-0,006
PETKM	2016	-0,447	+0,190	+0,441	+0,006	+0,005	+0,144	+0,012	-0,006
	2017	-0,447	+0,518	+0,441	+0,006	+0,005	+0,144	+0,012	-0,006
	2018	-0,447	+0,086	+0,441	+0,006	+0,005	+0,144	+0,012	-0,006
	2019	-0,447	+0,185	+0,441	+0,006	+0,005	+0,144	+0,012	-0,006
SAHOL	2016	-0,447	+0,190	+0,101	+0,006	+0,005	+0,144	+0,012	-0,006
	2017	-0,447	+0,518	+0,101	+0,006	+0,005	+0,144	+0,012	-0,006
	2018	-0,447	+0,086	+0,101	+0,006	+0,005	+0,144	+0,012	-0,006
	2019	-0,447	+0,185	+0,101	+0,006	+0,005	+0,144	+0,012	-0,006
SISE	2016	-0,447	+0,190	+0,538	+0,006	+0,005	+0,144	+0,012	-0,006
	2017	-0,447	+0,518	+0,538	+0,006	+0,005	+0,144	+0,012	-0,006
	2018	-0,447	+0,086	+0,538	+0,006	+0,005	+0,144	+0,012	-0,006
	2019	-0,447	+0,185	+0,538	+0,006	+0,005	+0,144	+0,012	-0,006
SODA	2016	-0,447	+0,190	+0,644	+0,006	+0,005	+0,144	+0,012	-0,006
	2017	-0,447	+0,518	+0,644	+0,006	+0,005	+0,144	+0,012	-0,006
	2018	-0,447	+0,086	+0,644	+0,006	+0,005	+0,144	+0,012	-0,006
	2019	-0,447	+0,185	+0,644	+0,006	+0,005	+0,144	+0,012	-0,006
TCELL	2016	-0,447	+0,190	-0,021	+0,006	+0,005	+0,144	+0,012	-0,006
	2017	-0,447	+0,518	-0,021	+0,006	+0,005	+0,144	+0,012	-0,006
	2018	-0,447	+0,086	-0,021	+0,006	+0,005	+0,144	+0,012	-0,006
	2019	-0,447	+0,185	-0,021	+0,006	+0,005	+0,144	+0,012	-0,006
THYAO	2016	-0,447	+0,190	+0,399	+0,006	+0,005	+0,144	+0,012	-0,006
	2017	-0,447	+0,518	+0,399	+0,006	+0,005	+0,144	+0,012	-0,006
	2018	-0,447	+0,086	+0,399	+0,006	+0,005	+0,144	+0,012	-0,006
	2019	-0,447	+0,185	+0,399	+0,006	+0,005	+0,144	+0,012	-0,006
KCHOL	2016	-0,447	+0,190	+0,117	+0,006	+0,005	+0,144	+0,012	-0,006
	2017	-0,447	+0,518	+0,117	+0,006	+0,005	+0,144	+0,012	-0,006
	2018	-0,447	+0,086	+0,117	+0,006	+0,005	+0,144	+0,012	-0,006
	2019	-0,447	+0,185	+0,117	+0,006	+0,005	+0,144	+0,012	-0,006

Table 18: Continue

ISE30	Year	Constant	Time	Stock	Swing	K5	MOM	PER	CMO
TUPRS	2016	-0,447	+0,190	+0,184	+0,006	+0,005	+0,144	+0,012	-0,006
	2017	-0,447	+0,518	+0,184	+0,006	+0,005	+0,144	+0,012	-0,006
	2018	-0,447	+0,086	+0,184	+0,006	+0,005	+0,144	+0,012	-0,006
	2019	-0,447	+0,185	+0,184	+0,006	+0,005	+0,144	+0,012	-0,006
VAKBN	2016	-0,447	+0,190	+0,062	+0,006	+0,005	+0,144	+0,012	-0,006
	2017	-0,447	+0,518	+0,062	+0,006	+0,005	+0,144	+0,012	-0,006
	2018	-0,447	+0,086	+0,062	+0,006	+0,005	+0,144	+0,012	-0,006
	2019	-0,447	+0,185	+0,062	+0,006	+0,005	+0,144	+0,012	-0,006
YKBNK	2016	-0,447	+0,190	-0,016	+0,006	+0,005	+0,144	+0,012	-0,006
	2017	-0,447	+0,518	-0,016	+0,006	+0,005	+0,144	+0,012	-0,006
	2018	-0,447	+0,086	-0,016	+0,006	+0,005	+0,144	+0,012	-0,006
	2019	-0,447	+0,185	-0,016	+0,006	+0,005	+0,144	+0,012	-0,006
EKGYO	2016	-0,447	+0,190	+0,094	+0,006	+0,005	+0,144	+0,012	-0,006
	2017	-0,447	+0,518	+0,094	+0,006	+0,005	+0,144	+0,012	-0,006
	2018	-0,447	+0,086	+0,094	+0,006	+0,005	+0,144	+0,012	-0,006
	2019	-0,447	+0,185	+0,094	+0,006	+0,005	+0,144	+0,012	-0,006
HALKB	2016	-0,447	+0,190	+0,053	+0,006	+0,005	+0,144	+0,012	-0,006
	2017	-0,447	+0,518	+0,053	+0,006	+0,005	+0,144	+0,012	-0,006
	2018	-0,447	+0,086	+0,053	+0,006	+0,005	+0,144	+0,012	-0,006
	2019	-0,447	+0,185	+0,053	+0,006	+0,005	+0,144	+0,012	-0,006
KOZAL	2016	-0,447	+0,190	+0,346	+0,006	+0,005	+0,144	+0,012	-0,006
	2017	-0,447	+0,518	+0,346	+0,006	+0,005	+0,144	+0,012	-0,006
	2018	-0,447	+0,086	+0,346	+0,006	+0,005	+0,144	+0,012	-0,006
	2019	-0,447	+0,185	+0,346	+0,006	+0,005	+0,144	+0,012	-0,006
TAVHL	2016	-0,447	+0,190	+0,201	+0,006	+0,005	+0,144	+0,012	-0,006
	2017	-0,447	+0,518	+0,201	+0,006	+0,005	+0,144	+0,012	-0,006
	2018	-0,447	+0,086	+0,201	+0,006	+0,005	+0,144	+0,012	-0,006
	2019	-0,447	+0,185	+0,201	+0,006	+0,005	+0,144	+0,012	-0,006
TEKFEN	2016	-0,447	+0,190	+0,446	+0,006	+0,005	+0,144	+0,012	-0,006
	2017	-0,447	+0,518	+0,446	+0,006	+0,005	+0,144	+0,012	-0,006
	2018	-0,447	+0,086	+0,446	+0,006	+0,005	+0,144	+0,012	-0,006
	2019	-0,447	+0,185	+0,446	+0,006	+0,005	+0,144	+0,012	-0,006
TTKOM	2016	-0,447	+0,190	+0,050	+0,006	+0,005	+0,144	+0,012	-0,006
	2017	-0,447	+0,518	+0,050	+0,006	+0,005	+0,144	+0,012	-0,006
	2018	-0,447	+0,086	+0,050	+0,006	+0,005	+0,144	+0,012	-0,006
	2019	-0,447	+0,185	+0,050	+0,006	+0,005	+0,144	+0,012	-0,006

Table 19: Coefficients By Years

Time	Coefficients
2016	0,190
2017	0,518
2018	0,086
2019	0,185

In Table 19 is given the panel regression coefficients for the years. Moving from this table, it can be said that 2017 is the most productive year and 2018 is the most inefficient year.

Table 20: Coefficients By Stocks

Stock	Coefficients	Stock	Coefficients
ARCLK	0,194	SODA	0,644
ASELS	0,338	TCELL	-0,021
BIMAS	0,169	THYAO	0,399
DOHOL	0,067	KCHOL	0,117
EREGL	0,353	TUPRS	0,184
FROTO	0,332	VAKBN	0,062
GARAN	0,016	YKBNK	-0,016
ISCTR	0,048	EKGYO	0,094
KCHOL	-0,111	HALKB	0,053
KOZAA	0,251	KOZAL	0,346
KRDMR	0,121	TAVHL	0,201
PETKM	0,441	TEKFEN	0,446
SAHOL	0,101	TTKOM	0,050
SISE	0,538		

In Table 20 is given the panel regression coefficients for the stocks. Moving from this table, it can be said that SODA is the most successful stock and KCHOL is the most unsuccessful stock. Also, it can be said that companies with a high return are Turkey Sise and Cam Factory AS, Soda Industry AS, and Tekfen Holding AS.

The panel regression equation for SODA, the most successful stock in the most successful year, is as follows:

return = –0,447 + 0,518 (2017) + 0,644 + 0,006 (Swing Index) + 0,005(StochasticFast) + 0,144 (MOM) + 0,012 (PER) -0,006(CMO)

The unit effect of soda in the most successful year is 0.644. The time effect of 2017 is also 0,518. At the same time, the return of the SODA stock; It is expected to increase by 6 units from a one-thousandth increase in the Swing Index, 5 units from a one-thousandth increase in the Stochastic Fast, 6 units from a one-thousandth increase in the Chande's Momentum Oscillator, 14 units from a one-percent increase in the Momentum and 1,2 units from a one-percent increase in the Price Earnings Ratio.

The panel regression equation for KCHOL, the most unsuccessful stock in the most successful year, is as follows:

return = –0,447 + 0,518 (2017) -0,111 + 0,006 (Swing Index) + 0,005(StochasticFast) + 0,144 (MOM) + 0,012 (PER) -0,006(CMO)

The unit effect of soda in the most successful year is -0,111. The time effect of 2017 is also 0,518. At the same time, the return of the KCHOL stock; It is expected to increase by 6 units from a one-thousandth increase in the Swing Index, 5 units from a one-thousandth increase in the Stochastic Fast, 6 units from a one-thousandth increase in the Chande's Momentum Oscillator, 14 units from a one-percent increase in the Momentum and 1,2 units from a one-percent increase in the Price Earnings Ratio.

The panel regression equation for SODA, the most successful stock in the most unsuccessful year, is as follows:

return = –0,447 + 0,086 (2018) + 0,644 + 0,006 (Swing Index) + 0,005(StochasticFast) + 0,144 (MOM) + 0,012 (PER) -0,006(CMO)

The unit effect of soda in the most successful year is 0.644. The time effect of 2017 is also 0,086. At the same time, the return of the SODA stock; It is expected to increase by 6 units from a one-thousandth increase in the Swing Index, 5 units from a one-thousandth increase in the Stochastic

Fast, 6 units from a one-thousandth increase in the Chande's Momentum Oscillator, 14 units from a one-percent increase in the Momentum and 1,2 units from a one-percent increase in the Price Earnings Ratio.

The panel regression equation for KCHOL, the most unsuccessful stock in the most unsuccessful year, is as follows:

$$return = -0,447 + 0,086(2018) - 0,111 + 0,006\ (Swing\ Index) + 0,005(StochasticFast) + 0,144\ (MOM) + 0,012\ (PER) - 0,006(CMO)$$

The unit effect of soda in the most successful year is -0,111. The time effect of 2018 is also 0,086. At the same time, the return of the KCHOL stock; It is expected to increase by 6 units from a one-thousandth increase in the Swing Index, 5 units from a one-thousandth increase in the Stochastic Fast, 6 units from a one-thousandth increase in the Chande's Momentum Oscillator, 14 units from a one-percent increase in the Momentum and 1,2 units from a one-percent increase in the Price Earnings Ratio.

5. CONCLUSION

The purpose of this study is to analyze the panel data models. Panel data is not single such as a cross-sectional data, and not very long such as time series. At the same time, it contains both analyses within. While it enables to see the effect of time when working with cross-section data, it enables to see the cross-section effect when working with time series. In addition, this data is obtained by multiple measurements on the same observations. The aim of this study is to examine the panel data algorithms on a specific application to find the most suitable model and also to compile the literature on panel data analysis. In the study, firstly the methods used in case of panel data were examined chronologically. In case the panel data is available, what are the assumptions needed to perform panel regression, which tests are examined, and information about this was given. When it is necessary to choose between panel regression models, it is stated which test is used for what purpose.

In the application part of the study, it was aimed to investigate in what way the shares traded on the stock exchange were explained by financial indicators and in which way they were affected. In relation to this, an application was made by using the data of ISE30 shares for the years 2015-2019 annual bases. However, these two stocks were excluded from the analysis since the shares of Enerjisa Enerji AS (ENJSA) and Emlak Konut Gayrimenkul Yatırım Ortaklığı AS (EKGYO) in ISE30 were found to be inadequate. A list of companies related to shares traded in ISE30 is given in Appendix -1. The application was used by calculating the return values of the remaining 28 stocks from the closing date. For this purpose, the return data was determined as the response variable. It is seen that there are 115 indicators that are considered to affect the stocks in the exchange investment programs (programs). These are given in Appendix-2. The majority of indicators provided in Appendix-2, primarily due to absence or not be calculated in Turkey, indicators are given in Appendix-3, a model was determined by considering the indicators as explanatory variables. Here, it was handled the relationship matrix without considering the time variable. Later, model was established by stepwise regression using the relationship matrix of the 37 variables. It is seen that the return variable is explained with the indicators of Swing index, Stochastic Fast (K5), Chande's Momentum Oscillator (CMO), Price Earnings Ratio (PER) and Momentum (MOM). In this model, it was found that the parameter coefficients of five indicators were significant. It can be said that the explanation rate of return of these variables is approximately 70% (R^2). Then, taking into consideration the time variable, too, it was investigated which panel regression would fit into our data. A random-effect model was decided by the Hausman test. However, a fixed-effect model was examined together with the random-effect model and in addition, the results for the fixed effect was given as a table in the application. When the results of these two models were examined, it was seen that there was no significant difference between them. Then, using the tests described in the literature review, which data were appropriate for the model was tested with binary comparisons. In these tests, the pooled regression model emerged in a different way. However, with the results of the pooled regression model, both the random model is given by the Hausman test and the results of the fixed effect model given for information purposes were not very different. In all of these models, the ratio of the five explanatory variables to explain the return-response variable was around 64-75%.

It would be expected that the ratio of these 5 variables affecting the shares of the firms traded on the stock exchange would be higher. So, the expectation was that this coefficient was higher. The question to be asked is how to explain the remaining 34%. This situation, the securities market in our country is thought to be caused by the fluctuations in domestic and foreign politics, unexpected movements in the Middle East region where our country is located, trade crisis between China and USA, fluctuations in international SMP finance, Shanghai and similar exchanges and the manipulation of the securities market, which is not as strong as the western regions, as well as the rules and conditions of the economy. It also leads to unforeseen ups and downs in the stock exchange rate in domestic policy fluctuations. So, in summary, it is seen that the situation affecting the securities market is not just financial indicators.

In addition, the last 5 years on an annual basis, it can be said that 2017 was the best return period for ISE30 companies. In 2018, there was a significant decrease compared to 2017. It is stated that it is in the normal course in 2019. It can be said that companies with a high return are Turkey Sise and Cam Factory AS, Soda Industry AS, and Tekfen Holding AS. Also, when the indicators are analyzed, it can be said that the variables that affect the return are respectively (highest to low) Momentum, Price Earnings Ratio, Swing Index, Chande's Momentum Oscillator and Stochastic Fast. The increase of Momentum Index by one per hundred increases the return by 14 unit. The increase of Swing Index by one per thousand increases the return by 6 units. The increase of Chande's Momentum Oscillator by one per thousand, increase the return by 6 unit. The increase of Stochastic Fast by one per thousand increases the return by 5 units. The increase of Price Earnings Ratio by one per hundred increases the return by 1,2 units. Here, for the future periods, Turkey Sise and Cam Factory AS, Soda Industry AS, and Tekfen Holding AS, these 3 shares can be offered for long term investors. If a portfolio is created, it can be suggested that 75% of Tekfen Holding AS, 17% of Turkey Sise and Cam Factory AS and 8% of Soda Industry AS 8%.

The mentioned data belongs to the years 2015-2019 and this period is a period in which economic uncertainties and frequent elections take place. Therefore, if a similar study is carried out in a more consistent period, different results can be obtained.

REFERENCES

[1] Unknown, Data Exploration (January, 2019) http://searchbusinessanalytics.techtarget.com/definition/data- exploration,

[2] Frees E., Longitudinal and Panel Data: Analysis and Applications For The Social Sciences, Cambridge University Press, Chapter 2, 30, **2004**

[3] Hsiao C. ,Analysis of Panel Data, Cambridge University Press, Second Edition, **2004**

[4] Baltes P B, Cornelius S W & Nesselroade J R., Cohort Effects İn Developmental Psychology, Longitudinal Research In The Study of Behavior And Development, New York: Academic Press, **1979**

[5] Dielman T.E., Pooled Cross-Sectional And Time Series Data Analysis, New York:Marcel Dekker, **1989**

[6] Kuh, E., The Validity of Cross-Sectionally Estimated Behavior Equations In Time Series Applications, Econometrica 27, 197–214, **1959**

[7] Johnson, P.R., Land Substitutes And Changes In Corn Yields. Journal Of Farm Econom., 42,294-306, **1960**

[8] Mundlak, Y., On the Pooling of Time Series and Cross-section Data. Econometrica 46: 69 85, **1978**

[9] Hoch I., Estimation of Production Function Parameters Combining Time-Series and Cross Section Data Econometrica,Volume 30, Issue 1, **1962**

[10] Balestra, P., Nerlove, M., Pooling Cross-Section And Time Series Data In The Estimation of A Dynamic Model: The Demand For Natural Gas. Econometrica 34: 585 612, **1966**

[11] Wallace, T.D., Hussain A., The Use of Error Components Models In Combining Cross Section With Time Series Data, Econometrica Vol. 37 pp. 55-72, **1969**

[12] Wishart, J., Growth-Rate Determinations In Nutrition Studies With The Bacon Pig, And Their Analysis. Biometrka, 30, 16-28, **1938**

[13] Rao, C.R., Some Problems Involving Linear Hypothesis In Multivariate Analysis, Biometrika,46,49-58, **1959**

[14] Rao, C.R., The Theory of Least Squares When Parameters Are Stochastic and Its Application To The Analysis of Growth Curves, Biometrika,46,49-58, **1965**

[15] Potthoff R.F. and Roy S.N., A Generalized Multivariate Analysis of Variance Moel Useful Especially For Growth Curve Problems, Biometrika, 51, 313-326, 1964

[16] Grizzle J.E. and Allen M.D., Analysis of Growth And Dose Response Curves, Biometrics, 25, 357-81, 1969

[17] Laird, N. M. and Ware, J. H., Random-effects models for longitudinal data. Biometrics, 38, 963-74, 1982

[18] Matyas L., Proper Econometric Specification of The Gravity Model, The World Economy, 20, 363-369, 1997

[19] Özekenci E., The Determinants Of E-Commerce In Turkey And European Countrıes: A Panel Data Analysıs, Cag University Master Thesis, 38, **2017**

[20] Frühwirth S. and Schnatter S., Panel Data Analysis: A Survey On Model-Based Clustering of Time Series, Springer Link, 251–280, **2011**

[21] Lee L., Yu J., Estimation of Fixed Effects Panel Regression Models with Separable and Nonseparable Space-Time Filter, Journal of Econometrics, 174–192, **2014**

[22] Balazsi L., Matyas L.,Wansbeek T., The Estimation of Multidimensional Fixed Effects Panel Data Models, Econometric Reviews, **2015**

[23] Born B., Breitung J., Testing for Serial Correlation in Fixed-Effects Panel Data Models, Econometric Reviews, 35:7, 1290-1316, **2016**

[24] Zhao S., Liu R., and Shang Z., Statistical Inference on Panel Data Models: A Kernel Ridge Regression Method, **2017**

[25] Greene, Econometric Analysis, New York University, Sixth Edition, Chapter 11, **2010**

[26] Tuna İ., Karaca S., The Estimation of The Increase of Capital of Industry Companies Registered In Borsa Istanbul (BIST30), Journal of Academic Research and Studies, Vol 7,12, **2015**

[27] Karaca S., Başçı E.S., The Ratios Affecting Stock Performance and Panel Data Analysis In ISE30 Index During 2001-2009, The Journal of Faculty Economics and Administrative Sciences, Vol 16, 3, 337-347, **2011**

[28] Baltagi B., Econometric Analysis of Panel Data, Third Edition, Chapter 2, 12, **2005**

[29] Richard Williams, University of Notre Dame, Lesson Notes, Panel Data for Linear Models: Very Brief Overview, 2, **2017,** https://www3.nd.edu/~rwilliam/

[30] Greene, Econometric Analysis, New York University, Sixth Edition, Chapter 11, **2010**

[31] Rodrıguez G., Models for Longitudinal and Clustered Data, **2012,** https://data.princeton.edu/wws509/notes/fixedRandom.pdf

[32] Ratanamaneichat C. And Schreyer S., A Panel Vector Autoregression Analysis of Sudden Stops and Banking Crises, Journal of International Business and Economics, Vol.3, No. 1, 24-33, **2015**

[33] Hoyos R., Sarafidis V., Testinf For Cross-Sectional Dependence in Panel Data Models, Stata Journal, StataCorp LP, vol. 6(4), 482-496, **2006**

[34] Torres O., Panel Data Analysis Fixed and Random Effects Using Stata, Princeton University, **2007,** https://www.princeton.edu/~otorres/Panel101.pdf

[35] Barbieri L., Panel Unıt Root Tests: A Revıew, Catholic University of the Sacred Heart, **2006,** http://www.unicatt.it/dipartimenti/ScEcoSoc/default.stm

[37] Guris S.Stata ile Panel Veri Modelleri, Chapter 9, 218, 2015

[38] Baltagi B.,Econometric Analysis of Panel Data, Third Edition, Chapter 12, 254, **2005**

[39] Hübler O., Panel Data Econometrics: Modelling and Estimation, University of Hannover, 6, **2005**

[40] Practical Guides To Panel Data Modeling: A Step by Step Analysis Using Stata, International University of Japan, 15, **2011**

[41] Sheytanova T., The Accuracy of the Hausman Test in Panel Data: a Monte Carlo Study, Orebro University, Advanced Level Thesis I, 14, **2014**

[42] Eviews 8 Users Guide II, IHS Global Inc, Chapter 6, 146, **2013**

[43] Arellona M., On Testing of Correlated Effects With Panel Data, Journal of Econometrics 59, 97, **1993**

[44] Unknown, How Traders Use CCI (Commodity Channel Index) To Trade Stock Trends (January, **2019**) https://www.investopedia.com/articles/active-trading/031914/how traderscan-utilize-cci-commodity-channel-index-trade-stock-trends.asp

[45] Unknown, What Does Moving Average Mean? (January, **2019**) https://www.investopedia.com/terms/m/movingaverage.asp

[46] Unknown, What is Moving Average Convergence Divergence (January, **2019**) https://www.investopedia.com/terms/m/macd.asp

[47] Unknown, Momentum (February, **2019**) https://www.tradingtechnologies.com/help/xstudy/technical-indicator-definitions/momentum-mom/

[48] Unknown, Can The Swing Index Accurately Predict Future Short-Term Price Action? (March, **2019**) https://commodity.com/technical-analysis/swing-index/

[49] Unknown, What is the Ichimoku Kinko Hyo (January, **2019**) https://www.investopedia.com/terms/i/ichimokuchart.asp

[50] Unknown,What is Senkou (Leading) Span B (February, **2019**) https://www.investopedia.com/terms/s/senkouspanb.asp

[51] Unknown, What is Senkou Span A (February, **2019**) https://www.investopedia.com/terms/s/senkouspana.asp

[52] Unknown, What is the Kijun Line (Base Line) (February, **2019**) https://www.investopedia.com/terms/k/kijun-line.asp

[53] Unknown, What is a Tenkan-Sen (February, **2019**) https://www.investopedia.com/terms/t/tenkansen.asp

[54] Unknown, Kairi Relative Index: The Forgotten Oscillator (February, **2019**) https://www.investopedia.com/articles/forex/09/kairi-relative-strength-index.asp

[55] Unknown, What Is The Relative Strength Index (February, **2019**) https://www.investopedia.com/terms/r/rsi.asp

[56] Unknown, Confirming Price Movements With Volume Oscillators (February, **2019**) https://www.investopedia.com/articles/technical/02/082702.asp

[57] Unknown, What is Williams %R? (February, **2019**) https://www.investopedia.com/terms/w/williamsr.asp

[58] Unknown, What is the Negative Directional Indicator (-DI)? (February, **2019**) https://www.investopedia.com/terms/n/negativedirectionalindicator.asp

APPENDIX 1: LIST OF ISE30

ISE30
Akbank TAS
Arcelik AS
Aselsan Elektronik Sanayi ve Ticaret AS
BIM Birlesik Magazalar AS
Doğan Şirketler Grubu Holding AS
Emlak Konut Gayrimenkul Yatırım Ortaklıgı AS
Enerjisa Enerji AS
Eregli Demir ve Celik Fabrikaları TAS
Ford Otomotiv Sanayi AS
Türkiye Garanti Bankası
Hacı Ömer Sabancı Holding AS
Kardemir Karabuk Demir Celik Sanayi ve Ticaret AS
Koc Holding AS
Koza Altin Isletmeleri AS
Koza Anadolu Metal Madencilik Isletmeleri AS
Pegasus Hava Tasımacılıgı AS
Petkim Petrokimya Holding AS
Türkiye Sise ve Cam Fabrikaları AS
Soda Sanayi AS
TAV Havalimanlari Holding
Tekfen Holding AS
Turk Hava Yollari AO
Tofas Turk Otomobil Fabrikası AS
Türkiye Petrol Rafinerileri AS
Turk Telekomunikasyon AS
Turkcell Iletisim Hizmetleri AS
Turkiye Is Bankasi AS
Turkiye Vakiflar Bankasi
Yapi ve Kredi Bankasi AS

APPENDIX 2: LIST OF INDICATORS-1

1	**BOL(20,2) U:**	Bollinger (20,Simple) U:
2	**BOL(20,2) M:**	Bollinger (20,Simple) M:
3	**BOL(20,2) D:**	Bollinger (20,Simple) D:
4	**A/D**	Accumulation/Distribution Ascillator (Acc./Dist.Asc.) (Line)
5	**ASwing**	Accumulation Swing Indeks (Acc/Swing Index) (3,Line)
6	**U(14)**	Aroon(14)
7	**D(14)**	Aroon(14)
8	**Aro.Osc.(14)**	Aroon Oscilattor (14)
9	**RSI(14)**	RSI(14,Line)
10	**ADX (14)**	Average Directional Movement Index (14,Line)
11	**ADXR (14,14)**	Average Directional Movement Index Rating (14,14,Line)
12	**ATR(14)**	Average True Range (14,Line)
13	**CO**	Chaikin Accumulation/Distribution Oscillator (3,10,Line)
14	**CMF(21)**	Chaikin Money Flow (21,Line)
15	**CHO(3,10)**	Chaikin Oscillator (3,10,Line)
16	**CMO(9)**	Chande’s Momentum Oscillator (9,Line)
17	**CCI(14)**	Commodity Channel Index (14,Line)
18	**CCIE(14)**	Commodity Channel Index(MS)(14,Line)
19	**CCIM(14)**	Commodity Channel Index(MTX)(14,Line)
20	**PMO(35,20)**	Decision Point Price Mom. Osc.(35,20)
21	**PMO Signal(10)**	Decision Point Price Mom. Osc.(35,20)
22	**DMI**	Demand Index (Line)
23	**DPO(20)**	Detrend Price Oscillator (20,Line)
24	**DI+(14)**	Directional Indicators + (14)
25	**DI-(14)**	Directional Indicators - (14)
26	**DX(14)**	Directional Index (14,Line)
27	**DCO**	Periodic Current Rate (Line)
28	**DFKB**	Periodic Activity Profit Growth (Line)
29	**DFKM**	Periodic Operating Profit Margin (Line)
30	**DKB**	Periodic Profit Growth (Line)
31	**DKK**	Periodic Wrapped Profit (Line)
32	**ENV(14,5) U:**	Envelopes (14,Simple) U:
33	**ENV(14,5) D:**	Envelopes (14,Simple) D:
34	**UST (50)**	High-Low Band Alt(50)
35	**ALT (50)**	High-Low Band Alt(50)
36	**DOSB**	Periodic Equity Growth (Line)
37	**DSB**	Periodic Sales Growth (Line)
38	**EOM(14)**	Ease Of Movement (Period, Method S E W TRI VAR)

39	**EWO(5,34)**	Elliott Wave Oscillator (Short Period, Long Period)
40	**Fish T.(10)**	Fisher Transform(10,Line)
41	**Fish T.2(10)**	Fisher Transform 2 (10,Line)
42	**PER**	Price Earnings Ratio(Line)
43	**HVLT(21)**	Historical Volatility(21,Line)
44	**Open**	Heiken Ashi(0)
45	**High**	Heiken Ashi(0)
46	**Low**	Heiken Ashi(0)
47	**Close**	Heiken Ashi(0)
48	**Tenkan-sen**	Ichi Moku(9,Line)
49	**Kijun-sen**	Ichi Moku(9,Line)
50	**Chikou Span**	Ichi Moku(9,Line)
51	**Senkou Span A**	Ichi Moku(9,Line)
52	**Senkou Span B**	Ichi Moku(9,Line)
53	**Linearreg(14)**	Lineer Regression (14,Line)
54	**MOST(14,% 25)**	Moving Stop Loss(14,Line)
55	**ExMOV(14)**	Moving Stop Loss(14,Line)
56	**MAV(5)**	Moving Average(5,Line)
57	**MAV(22)**	Moving Average (5,Line)
58	**MAV(5)**	Moving Average(5,Simple))
59	**MSL(% 5)**	Moving Stoploss(5, Open)
60	**IMI(14)**	Intraday Momentum Index(14,Line)
61	**KAI(14)**	Kairi (14,Close,Line))
62	**LRS(14)**	LRS Linear Regression Slope (14,Line)
63	**MACD(26,12)**	MOVİNG AVERAGE Conv.Div.(26,12,Line,Line)
64	**TRIGGER(9)**	MOVİNG AVERAGE Conv.Div.(26,12,Line,Line)
65	**MACD-AS(26,12)**	MOVİNG AVERAGE Conv.Div.-AS (26,Line)
66	**AS TRIGGER(9)**	MOVİNG AVERAGE Conv.Div.-AS (26,Line)
67	**MJR(14)**	Majority Rule(14,Line)
68	**MASS(9,25)**	Mass Index(9,25,Line)
69	**MOM(9)**	Momentum(9,Line)
70	**MFI(14)**	Money Flow Index(14,Line)
71	**NVI**	Negative Volume Index(Line)
72	**OBV**	On Balance Volume(Line, Close)
73	**OBVx(14)**	On Balance Volume Ex(14,Line)
74	**PAR**	Parabolic(0,02,0,2)
75	**PSAR**	Parabolic SAR(0, Point)
76	**SAR**	Parabolic SAR(MTX)(0, Point)
77	**PD**	Marketing Value (Line)

78	**PD/DD**	Market to Book Value Ratio (Line)
79	**PVI**	Positive Volume Index(Line)
80	**POSC(5,22)**	Price Oscillator(5,22,Line,Simple,$)
81	**PROC(14)**	Price Rate Of Change(14,Line)
82	**Fast**	Quantitative Qualitative Estimation Fast
83	**Slow**	Quantitative Qualitative Estimation Slow
84	**RMI(20,5)**	Relative Momentum Index(20,Line)
85	**RSI(14)**	Relative Strength Index(14,Line)
86	**r-squared (14)**	R-Squared(14,Line)
87	**TILL(3)**	Tillson Mov.Avg(3,Line)
88	**TSF(3)**	Time Series Forecast(3,Line)
89	**%K(5,3,3)**	Stochastic Momentum Index(5,3,3,3)
90	**%D(3)**	Stochastic Momentum Index(5,3,3,3)
91	**SRSI(14,7)**	Stochastic RSI(14,Line)
92	**Swing**	Swing Index(3,Line)
93	**%K(5)**	Stochastic Fast(5,3,Line,Line)
94	**%D(3)**	Stochastic Fast(5,3,Line,Line)
95	**%K(5,5)**	Stochastic Slow(5,3,Line,5,Line)
96	**%D(3)**	Stochastic Slow(5,3,Line,5,Line)
97	**Tem.Ver.**	Dividend Yield (%)(Line)
98	**TVI(50)**	Trade Volume Index(50,Line)
99	**TRIX(12)**	TRIX(Kapanış,12,Line,9,1,Line)
100	**MAV(9)**	TRIX(Kapanış,12,Line,9,1,Line)
101	**ULT(7,14,28)**	Ultimate Oscillator(12,4,0)
102	**WCL**	Weighted Close(Line)
103	**H.VOL**	Horizontal Volume Bars
104	**ZigZag(%5)**	ZIGZAG(1,Line)
105	**VHF(28)**	Vertical Horizantal Filter(28,Line)
106	**VLT(10)**	Volatility(10,Line)
107	**VOSC(5,22)**	Volume Oscillator(5,22,Line,Simple)
108	**VPT**	Volume Price Trend(Line)
109	**VROC(12)**	Volume Rate Of Change(12,Line)
110	**VI+(14)**	Vortex (14,Line)
111	**VI-(14)**	Vortex (14,Line)
112	**WLR(14)**	William's %R(14,Line)
113	**Will A/D**	William's A/D (Line)
114	**WAD(14)**	William's A/D (14,Line)
115	**VLTYZ(14)**	Yang-Zhang Volatility (14,Line)

APPENDIX 3: LIST OF INDICATORS-2

1	A/D
2	ASwing
3	CO
4	CHO(3,10)
5	CMO
6	DKB
7	DKK
8	DOSB
9	PER
10	Open
11	High
12	Low
13	Close
14	MAV(5)
15	MAV(5)
16	MSL(% 5)
17	PAR
18	PSAR
19	SAR
20	MOM
21	NVI
22	OBV
23	PD
24	PD/DD
25	PVI
26	TILL(3)
27	TSF(3)
28	WCL
29	ZigZag(%5)
30	Swing
31	%K(5)
32	%D(3)
33	%K(5,5)
34	%D(3)
35	TVI(50)
36	VPT
37	Will A/D

APPENDIX 4: THE RESULT OF MODELS

```
Random-effects GLS regression                   Number of obs      =       140
Group variable: stock                           Number of groups   =        28

R-sq:                                           Obs per group:
     within  = 0.6892                                         min =          5
     between = 0.4482                                         avg =        5.0
     overall = 0.6480                                         max =          5

                                                Wald chi2(5)       =    251.10
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
      return |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        CMO9 |  -.0063365   .0014011    -4.52   0.000    -.0090827   -.0035903
         PER |   .0129472   .0027152     4.77   0.000     .0076254    .0182689
       Swing |   .0059723   .0006916     8.63   0.000     .0046167    .0073279
          K5 |   .0050811   .0016074     3.16   0.002     .0019307    .0082315
      logmom |   .1442333   .0423124     3.41   0.001     .0613025    .2271641
       _cons |  -.4475832   .1039081    -4.31   0.000    -.6512393   -.2439271
-------------+----------------------------------------------------------------
     sigma_u |  .04472083
     sigma_e |  .27662684
         rho |  .02546985   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

```
Random-effects ML regression                    Number of obs      =       140
Group variable: stock                           Number of groups   =        28

Random effects u_i ~ Gaussian                   Obs per group:
                                                              min =          5
                                                              avg =        5.0
                                                              max =          5

                                                LR chi2(5)         =    146.36
Log likelihood  = -19.223784                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
      return |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        CMO9 |  -.0063393   .0013801    -4.59   0.000    -.0090443   -.0036344
         PER |   .0129588   .0027227     4.76   0.000     .0076223    .0182952
       Swing |   .0059752   .0006923     8.63   0.000     .0046184     .007332
          K5 |   .0050762    .001593     3.19   0.001     .0019539    .0081984
      logmom |   .1444524   .0429284     3.36   0.001     .0603143    .2285905
       _cons |  -.4478461   .1026169    -4.36   0.000    -.6489715   -.2467207
-------------+----------------------------------------------------------------
    /sigma_u |    .045499   .0592069                       .003551    .5829774
    /sigma_e |    .274024   .0186121                      .2398689    .3130425
         rho |   .0268297   .0695662                      .0000182    .6062131
------------------------------------------------------------------------------
LR test of sigma_u=0: chibar2(01) = 0.16             Prob >= chibar2 = 0.343
```

```
Between regression (regression on group means)  Number of obs      =       140
Group variable: stock                           Number of groups   =        28

R-sq:                                           Obs per group:
     within  = 0.6564                                         min =          5
     between = 0.4964                                         avg =        5.0
     overall = 0.6240                                         max =          5

                                                F(5,22)            =      4.34
sd(u_i + avg(e_i.))=  .1315463                  Prob > F           =    0.0067

------------------------------------------------------------------------------
      return |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        CMO9 |  -.0037898   .0024698    -1.53   0.139    -.0089117    .0013322
         PER |   .0060837   .0055767     1.09   0.287    -.0054816     .017649
       Swing |    .003239   .0015901     2.04   0.054    -.0000586    .0065366
          K5 |   .0060104   .0034797     1.73   0.098    -.0012059    .0132268
      logmom |   .0668607   .0568811     1.18   0.252    -.0511034    .1848248
       _cons |  -.3094011   .1916327    -1.61   0.121    -.7068231    .0880209
------------------------------------------------------------------------------
```

```
Mixed-effects ML regression                     Number of obs      =       140

                                                Wald chi2(5)       =    257.78
Log likelihood = -19.305555                     Prob > chi2        =    0.0000

------------------------------------------------------------------------------
      return |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        CMO9 |  -.0062803   .0013397    -4.69   0.000    -.0089061   -.0036546
         PER |   .0127187    .002639     4.82   0.000     .0075464     .017891
       Swing |   .0059143   .0006761     8.75   0.000     .0045892    .0072394
          K5 |   .0051783   .0015664     3.31   0.001     .0021081    .0082484
      logmom |   .1400008   .0404686     3.46   0.001     .0606837    .2193179
       _cons |  -.4425585   .1001823    -4.42   0.000    -.6389122   -.2462048
------------------------------------------------------------------------------


------------------------------------------------------------------------------
  Random-effects Parameters  |   Estimate   Std. Err.     [95% Conf. Interval]
-----------------------------+------------------------------------------------
                sd(Residual) |   .2777478   .0165986      .2470482    .3122624
------------------------------------------------------------------------------
```

GEE population-averaged model		Number of obs =	140
Group variable:	stock	Number of groups =	28
Link:	identity	Obs per group:	
Family:	Gaussian	min =	5
Correlation:	exchangeable	avg =	5.0
		max =	5
		Wald chi2(5) =	262.57
Scale parameter:	.0771593	Prob > chi2 =	0.0000

return	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
CM09	-.0063393	.0013724	-4.62	0.000	-.0090293	-.0036494
PER	.0129588	.0026573	4.88	0.000	.0077506	.0181669
Swing	.0059752	.0006767	8.83	0.000	.0046489	.0073015
K5	.0050762	.0015729	3.23	0.001	.0019934	.008159
logmom	.1444524	.0414433	3.49	0.000	.063225	.2256797
_cons	-.447846	.1017335	-4.40	0.000	-.6472401	-.248452

APPENDIX 5: THE RESULT OF HAUSMAN TEST

```
. hausman fe re

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |       fe           re         Difference          S.E.
-------------+----------------------------------------------------------------
        CM09 |   -.0070095    -.0063365       -.000673        .0022396
         PER |    .0162658     .0129472       .0033186        .0018398
      logmom |    .2201788     .1442333       .0759455        .0491091
       Swing |    .0064824     .0059723       .0005101          .00042
          K5 |    .0037398     .0050811      -.0013414         .000972
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        9.56
                Prob>chi2 =      0.0885
```

APPENDIX 6: THE RESULT OF HETEROSKEDASTICITY

```
Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (28)  =    4419.52
Prob>chi2 =      0.0000
```

```
       robvar res, by(stock)

             |          Summary of e[stock,t]
       stock |        Mean    Std. Dev.        Freq.
-------------+-----------------------------------------
           1 |   3.725e-10    .07165554            5
           2 |  -2.235e-09    .24716683            5
           3 |   1.490e-09    .26243884            5
           4 |           0    .35442613            5
           5 |  -1.490e-09     .1621099            5
           6 |   4.470e-09    .27888701            5
           7 |  -3.725e-10    .09141061            5
           8 |   2.980e-09     .1539576            5
           9 |  -1.863e-09     .1353442            5
          10 |  -2.794e-09    .17828758            5
          11 |   5.960e-09    .34724948            5
          12 |           0    .23845406            5
          13 |   2.980e-09    .39823214            5
          14 |   7.451e-10    .11077149            5
          15 |   3.166e-09    .23016706            5
          16 |   7.451e-10    .12846356            5
          17 |   1.490e-09    .11792533            5
          18 |   5.960e-09    .44282342            5
          19 |  -3.725e-10    .27618229            5
          20 |   1.490e-09    .29520435            5
          21 |   7.451e-10    .13195018            5
          22 |  -2.980e-09    .21683128            5
          23 |           0            0            1
          24 |  -9.313e-10    .07553123            4
          25 |           0            0            1
          26 |   9.313e-10    .12423675            4
          27 |           0    .45989982            4
          28 |  -2.484e-09    .17748349            3
-------------+-----------------------------------------
       Total |   7.480e-10    .21769384          127

W0  =  2.2539350   df(27, 99)     Pr > F = 0.00198095

W50 =  1.0444494   df(27, 99)     Pr > F = 0.42066089

W10 =  2.2539350   df(27, 99)     Pr > F = 0.00198095
```

APPENDIX 7: THE RESULT OF AUTOCORRELATION

```
FE (within) regression with AR(1) disturbances  Number of obs      =        99
Group variable: stock                           Number of groups   =        26

R-sq:                                           Obs per group:
     within  = 0.7770                                         min =          2
     between = 0.2862                                         avg =        3.8
     overall = 0.6478                                         max =          4

                                                F(5,68)            =     47.38
corr(u_i, Xb)  = -0.3347                        Prob > F           =    0.0000

------------------------------------------------------------------------------
      return |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       Swing |   .0067557   .0009861     6.85   0.000     .0047881    .0087234
         PER |   .0035005   .0028446     1.23   0.223    -.0021757    .0091768
      logmom |   .4165124   .0844749     4.93   0.000     .2479454    .5850794
          FK |   .0193011   .0040713     4.74   0.000     .0111771    .0274252
        CM09 |  -.0190066   .0041691    -4.56   0.000     -.027326   -.0106873
       _cons |  -1.934482   .4202754    -4.60   0.000    -2.773128   -1.095835
-------------+----------------------------------------------------------------
      rho_ar |  -.03040098
     sigma_u |   .21305162
     sigma_e |   .25905912
     rho_fov |   .40346608   (fraction of variance because of u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(25,68) = 1.38                       Prob > F = 0.1497
modified Bhargava et al. Durbin-Watson = 2.0552814
Baltagi-Wu LBI = 2.3724231
```

```
Tests for the error component model:

        return[stock,t] = Xb + u[stock] + v[stock,t]
           v[stock,t] = lambda v[stock,(t-1)] + e[stock,t]

        Estimated results:
                         |       Var     sd = sqrt(Var)
                ---------+-----------------------------
                  return |   .2207661       .4698575
                       e |   .0765224       .27662684
                       u |       .002       .04472083

        Tests:
           Random Effects, Two Sided:
           ALM(Var(u)=0)         =    0.05 Pr>chi2(1) =  0.8163

           Random Effects, One Sided:
           ALM(Var(u)=0)         =   -0.23 Pr>N(0,1)  =  0.5919

           Serial Correlation:
           ALM(lambda=0)         =    0.70 Pr>chi2(1) =  0.4033

           Joint Test:
           LM(Var(u)=0,lambda=0) =    0.84 Pr>chi2(2) =  0.6555
```

APPENDIX 8: THE RESULT OF CROSS-SECTIONAL DEPENDENCE

. xtcsd, pesaran show

Correlation matrix of residuals:

	c1	c2	c3	c4	c5	c6	c7	c8	c9	c10	c11	c12	c13	c14	c15	c16	c17	c18	c19
r1	1.0000																		
r2	0.1134	1.0000																	
r3	-0.1008	0.1527	1.0000																
r4	0.7186	-0.5967	-0.0865	1.0000															
r5	0.4134	-0.0389	0.1366	0.2988	1.0000														
r6	0.3062	-0.4293	0.4475	0.5431	0.8144	1.0000													
r7	-0.3895	-0.0448	0.8726	-0.2250	0.3207	0.5778	1.0000												
r8	0.8373	0.3063	-0.5427	0.4036	0.2523	-0.1119	-0.7442	1.0000											
r9	0.8717	-0.1221	0.2939	0.8131	0.5453	0.6686	0.0560	0.4705	1.0000										
r10	0.0420	0.8977	-0.2840	-0.6273	-0.1449	-0.6534	-0.3874	0.4460	-0.3494	1.0000									
r11	-0.1252	-0.5864	0.3345	0.2861	0.6893	0.8878	0.6548	-0.4232	0.2640	-0.7076	1.0000								
r12	0.3797	-0.4108	0.6564	0.6483	0.5062	0.8808	0.5819	-0.1695	0.7838	-0.7371	0.6701	1.0000							
r13	-0.2564	-0.6165	0.5504	0.2459	0.4476	0.8157	0.7910	-0.6482	0.2182	-0.8185	0.9357	0.7458	1.0000						
r14	0.5359	0.8890	-0.0074	-0.1849	0.0465	-0.3360	-0.3223	0.6703	0.2333	0.8121	-0.6526	-0.2671	-0.7301	1.0000					
r15	0.4438	0.5535	0.7045	0.0159	0.5329	0.4616	0.5077	0.1458	0.5909	0.1779	0.1430	0.5214	0.1426	0.5689	1.0000				
r16	-0.3576	0.4144	-0.5781	-0.6759	0.0375	-0.4730	-0.3124	0.1624	-0.6755	0.7039	-0.2362	-0.8247	-0.4498	0.2160	-0.2834	1.0000			
r17	0.0342	-0.7394	0.5009	0.6145	0.0521	0.6181	0.4697	-0.4570	0.4533	-0.9504	0.5805	0.8269	0.7660	-0.6482	0.0201	-0.8753	1.0000		
r18	-0.2187	-0.4081	0.8080	0.1732	0.3170	0.7435	0.9033	-0.6948	0.2860	-0.7337	0.7762	0.8136	0.9320	-0.5413	0.3630	-0.6128	0.7958	1.0000	
r19	0.4462	0.8426	0.1632	-0.1809	-0.2223	-0.4336	-0.2502	0.4936	0.2079	0.7007	-0.7561	-0.2038	-0.7068	0.9347	0.5373	-0.0130	-0.4625	-0.4297	1.0000
r20	-0.2955	-0.3276	0.8720	0.0799	0.0933	0.5701	0.8915	-0.7669	0.1969	-0.6749	0.6026	0.7383	0.8324	-0.4907	0.3390	-0.6630	0.7904	0.9685	-0.3023
r21	0.6967	-0.2751	0.4817	0.8070	0.4358	0.7288	0.2557	0.1942	0.9516	-0.5628	0.3787	0.9150	0.4245	0.0190	0.5494	-0.8524	0.6899	0.5230	0.0776
r22	0.6662	-0.3391	0.4695	0.8283	0.4062	0.7305	0.2546	0.1578	0.9342	-0.6166	0.3989	0.9230	0.4547	-0.0453	0.4944	-0.8756	0.7352	0.5431	0.0246
r23	0.7045	0.6392	-0.2216	0.0663	0.5070	0.0266	-0.3597	0.8438	0.4159	0.6442	-0.2749	-0.1223	-0.5198	0.8360	0.5333	0.3254	-0.6167	-0.5046	0.6026
r24	-0.7774	-0.2069	-0.4972	-0.5126	-0.6400	-0.6521	-0.2660	-0.3978	-0.9156	0.1070	-0.2437	-0.7285	-0.1944	-0.4400	-0.8621	0.5207	-0.2574	-0.3313	-0.3880
r25	-0.4403	-0.9148	0.0373	0.3066	-0.2302	0.2475	0.2298	-0.6284	-0.1465	-0.8618	0.4987	0.3099	0.6432	-0.9582	-0.5917	-0.4090	0.7546	0.5135	-0.8115
r26	-0.2829	-0.4626	-0.4892	-0.0164	0.4727	0.2976	-0.0179	-0.0814	-0.2771	-0.2019	0.5896	-0.1389	0.3500	-0.5401	-0.4405	0.5197	-0.1013	0.0024	-0.7964
r27	-0.5964	-0.6419	0.4169	-0.0150	0.1704	0.5378	0.7355	-0.8460	-0.1658	-0.7453	0.8182	0.4544	0.9205	-0.8743	-0.1529	-0.2473	0.6533	0.8247	-0.8158
r28	0.6683	0.0010	0.4193	0.5360	0.8583	0.8537	0.3632	0.3018	0.8662	-0.2610	0.5452	0.7820	0.4254	0.1966	0.7616	-0.4108	0.3123	0.4475	0.0633

	c20	c21	c22	c23	c24	c25	c26	c27	c28
r20	1.0000								
r21	0.4650	1.0000							
r22	0.4869	0.9974	1.0000						
r23	-0.5956	0.1336	0.0707	1.0000					
r24	-0.2527	-0.8502	-0.8104	-0.5614	1.0000				
r25	0.5121	0.0913	0.1611	-0.8950	0.4092	1.0000			
r26	-0.1916	-0.3300	-0.3100	-0.0739	0.3510	0.3149	1.0000		
r27	0.7701	0.0756	0.1191	-0.7494	0.1947	0.7767	0.4361	1.0000	
r28	0.2939	0.8060	0.7747	0.4923	-0.9309	-0.2494	0.0018	0.0474	1.0000

Pesaran's test of cross sectional independence = 4.678, Pr = 0.0000

. xtcsd, friedman show

Correlation matrix of residuals:

	c1	c2	c3	c4	c5	c6	c7	c8	c9	c10	c11	c12	c13	c14	c15	c16	c17	c18	c19
r1	1.0000																		
r2	0.1134	1.0000																	
r3	-0.1008	0.1527	1.0000																
r4	0.7186	-0.5967	-0.0865	1.0000															
r5	0.4134	-0.0389	0.1366	0.2988	1.0000														
r6	0.3062	-0.4293	0.4475	0.5431	0.8144	1.0000													
r7	-0.3895	-0.0448	0.8726	-0.2250	0.3207	0.5778	1.0000												
r8	0.8373	0.3063	-0.5427	0.4036	0.2523	-0.1119	-0.7442	1.0000											
r9	0.8717	-0.1221	0.2939	0.8131	0.5453	0.6686	0.0560	0.4705	1.0000										
r10	0.0420	0.8977	-0.2840	-0.6273	-0.1449	-0.6534	-0.3874	0.4460	-0.3494	1.0000									
r11	-0.1252	-0.5864	0.3345	0.2861	0.6893	0.8878	0.6548	-0.4232	0.2640	-0.7076	1.0000								
r12	0.3797	-0.4108	0.6564	0.6483	0.5062	0.8808	0.5819	-0.1695	0.7838	-0.7371	0.6701	1.0000							
r13	-0.2564	-0.6165	0.5504	0.2459	0.4476	0.8157	0.7910	-0.6482	0.2182	-0.8185	0.9357	0.7458	1.0000						
r14	0.5359	0.8890	-0.0074	-0.1849	0.0465	-0.3360	-0.3223	0.6703	0.2333	0.8121	-0.6526	-0.2671	-0.7301	1.0000					
r15	0.4438	0.5535	0.7045	0.0159	0.5329	0.4616	0.5077	0.1458	0.5909	0.1779	0.1430	0.5214	0.1426	0.5689	1.0000				
r16	-0.3576	0.4144	-0.5781	-0.6759	0.0375	-0.4730	-0.3124	0.1624	-0.6755	0.7039	-0.2362	-0.8247	-0.4498	0.2160	-0.2834	1.0000			
r17	0.0342	-0.7394	0.5009	0.6145	0.0521	0.6181	0.4697	-0.4570	0.4533	-0.9504	0.5805	0.8269	0.7660	-0.6482	0.0201	-0.8753	1.0000		
r18	-0.2187	-0.4081	0.8080	0.1732	0.3170	0.7435	0.9033	-0.6948	0.2860	-0.7337	0.7762	0.8136	0.9320	-0.5413	0.3630	-0.6128	0.7958	1.0000	
r19	0.4462	0.8426	0.1632	-0.1809	-0.2223	-0.4336	-0.2502	0.4936	0.2079	0.7007	-0.7561	-0.2038	-0.7068	0.9347	0.5373	-0.0130	-0.4625	-0.4297	1.0000
r20	-0.2955	-0.3276	0.8720	0.0799	0.0933	0.5701	0.8915	-0.7669	0.1969	-0.6749	0.6026	0.7383	0.8324	-0.4907	0.3390	-0.6630	0.7904	0.9685	-0.3023
r21	0.6967	-0.2751	0.4817	0.8070	0.4358	0.7288	0.2557	0.1942	0.9516	-0.5628	0.3787	0.9150	0.4245	0.0190	0.5494	-0.8524	0.6899	0.5230	0.0776
r22	0.6662	-0.3391	0.4695	0.8283	0.4062	0.7305	0.2546	0.1578	0.9342	-0.6166	0.3989	0.9230	0.4547	-0.0453	0.4944	-0.8756	0.7352	0.5431	0.0246
r23	0.7045	0.6392	-0.2216	0.0663	0.5070	0.0266	-0.3597	0.8438	0.4159	0.6442	-0.2749	-0.1223	-0.5198	0.8360	0.5333	0.3254	-0.6167	-0.5046	0.6026
r24	-0.7774	-0.2069	-0.4972	-0.5126	-0.6400	-0.6521	-0.2660	-0.3978	-0.9156	0.1070	-0.2437	-0.7285	-0.1944	-0.4400	-0.8621	0.5207	-0.2574	-0.3313	-0.3880
r25	-0.4403	-0.9148	0.0373	0.3066	-0.2302	0.2475	0.2298	-0.6284	-0.1465	-0.8618	0.4987	0.3099	0.6432	-0.9582	-0.5917	-0.4090	0.7546	0.5135	-0.8115
r26	-0.2829	-0.4626	-0.4892	-0.0164	0.4727	0.2976	-0.0179	-0.0814	-0.2771	-0.2019	0.5896	-0.1389	0.3500	-0.5401	-0.4405	0.5197	-0.1013	0.0024	-0.7964
r27	-0.5964	-0.6419	0.4169	-0.0150	0.1704	0.5378	0.7355	-0.8460	-0.1658	-0.7453	0.8182	0.4544	0.9205	-0.8743	-0.1529	-0.2473	0.6533	0.8247	-0.8158
r28	0.6683	0.0010	0.4193	0.5360	0.8583	0.8537	0.3632	0.3018	0.8662	-0.2610	0.5452	0.7820	0.4254	0.1966	0.7616	-0.4108	0.3123	0.4475	0.0633

	c20	c21	c22	c23	c24	c25	c26	c27	c28
r20	1.0000								
r21	0.4650	1.0000							
r22	0.4869	0.9974	1.0000						
r23	-0.5956	0.1336	0.0707	1.0000					
r24	-0.2527	-0.8502	-0.8104	-0.5614	1.0000				
r25	0.5121	0.0913	0.1611	-0.8950	0.4092	1.0000			
r26	-0.1916	-0.3300	-0.3100	-0.0739	0.3510	0.3149	1.0000		
r27	0.7701	0.0756	0.1191	-0.7494	0.1947	0.7767	0.4361	1.0000	
r28	0.2939	0.8060	0.7747	0.4923	-0.9309	-0.2494	0.0018	0.0474	1.0000

Friedman's test of cross sectional independence = 10.486, Pr = 0.9982

APPENDIX 9: THE RESULT OF UNIT ROOT

```
Pesaran's CADF test for return
Cross-sectional average in first period extracted and extreme t-values truncated
Deterministics chosen: constant

t-bar test, N,T = (28,5)          Obs = 112
Augmented by 0 lags (average)

    t-bar      cv10      cv5       cv1   Z[t-bar]    P-value
    2.610   -2.100    -2.220    -2.440   16.980     1.000
```

```
Im-Pesaran-Shin unit-root test for return
-----------------------------------------
Ho: All panels contain unit roots           Number of panels  =     28
Ha: Some panels are stationary              Number of periods =      5

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                        sequentially
Time trend:   Not included

ADF regressions: 0.00 lags average (chosen by BIC)
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar            -10.2204        0.0000
------------------------------------------------------------------------------
```

APPENDIX 10: THE RESULT OF PANEL COINTEGRATION

```
Kao test for cointegration
--------------------------
Ho: No cointegration                        Number of panels       =     28
Ha: All panels are cointegrated             Number of periods      =      3

Cointegrating vector: Same
Panel means:          Included              Kernel:            Bartlett
Time trend:           Not included          Lags:              0.82 (Newey-West)
AR parameter:         Same                  Augmented lags:    1
------------------------------------------------------------------------------
                                            Statistic          p-value
------------------------------------------------------------------------------
 Modified Dickey-Fuller t                     1.6014           0.0546
 Dickey-Fuller t                             -4.5867           0.0000
 Augmented Dickey-Fuller t                  -11.2763           0.0000
 Unadjusted modified Dickey-Fuller t         -1.6474           0.0497
 Unadjusted Dickey-Fuller t                  -7.3172           0.0000
------------------------------------------------------------------------------
```

HACETTEPE UNIVERSITY
GRADUATE SCHOOL OF SCIENCE AND ENGINEERING
THESIS/~~DISSERTATION~~ ORIGINALITY REPORT

HACETTEPE UNIVERSITY
GRADUATE SCHOOL OF SCIENCE AND ENGINEERING
TO THE DEPARTMENT OF STATISTICS

Date: 27/06/2019

Thesis Title / Topic: EVALUATION OF PANEL DATA MODELS AND AN APPLICATION ON ISE30
According to the originality report obtained by my thesis advisor by using the *Turnitin* plagiarism detection software and by applying the filtering options stated below on 25/06/2019 for the total of 59 pages including the a) Title Page, b) Introduction, c) Main Chapters, d) Conclusion sections of my thesis entitled as above, the similarity index of my thesis is 9 %.

Filtering options applied:

1. Bibliography/Works Cited excluded
2. Quotes excluded
3. Match size up to 5 words excluded

I declare that I have carefully read Hacettepe University Graduate School of Sciene and Engineering Guidelines for Obtaining and Using Thesis Originality Reports; that according to the maximum similarity index values specified in the Guidelines, my thesis does not include any form of plagiarism; that in any future detection of possible infringement of the regulations I accept all legal responsibility; and that all the information I have provided is correct to the best of my knowledge.

I respectfully submit this for approval.

27/06/2019
Date and Signature

Name Surname:	EDA SELİN ILIKKAN
Student No:	N14325677
Department:	STATISTICS
Program:	Masters With Thesis
Status:	☒ Masters ☐ Ph.D. ☐ Integrated Ph.D.

ADVISOR APPROVAL

APPROVED.

Prof. Dr. Hüseyin Tatlıdil
(Title, Name Surname, Signature)

CURRICULUM VITAE

I – Personel Information:

Name **:** Eda Selin ILIKKAN

Date And Place Of Birth **:** 28.07.1992 / Ankara

Nationality **:** T.C.

Contact Address and Phone: edaselinilikkan@gmail.com / 0533 167 57 19

II – Education:

Master's Degree : Hacettepe University, Statistics

University : Hacettepe University, Statistics, (June 2014, 3.44/4.00 3rd in department ranking)

High School : Sokullu Mehmet Paşa High School, (June 2010, 84.21/100)

Languages : Turkish, English

III – Professional Experience:

2016 - Department of Implementation and Data Management of Revenue Administration (II) Department of Data, Follow-Up, Evaluation and Statistics, Assistant of Revenue Expert