PAIRS TRADING IN XU100

ÜMİT KIVANÇ BATTAL

106622003

ISTANBUL BILGI UNIVERSITY

INSTITUTE OF SOCIAL SCIENCES

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ASST. PROF. DR. ORHAN ERDEM

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IMKB 100 DE İKİLİ ALIM SATIM

ÜMİT KIVANÇ BATTAL

106622003

ASST. PROF. DR. ORHAN ERDEM…………………………….

ASSOC. PROF. DR. EGE YAZGAN…………………………..

ASST. PROF. DR. KORAY AKAY…………………………….

Tezin Onaylandığı Tarih:………………………………………………….

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ABSTRACT

In this paper, we have studied market behavioral (market friendly) pairs trading. The idea in pairs trading is basically to determine the long run relationships between the prices of two financial assets, and take the advantage of the short run deviations from this relationship. Pair trading is based on the idea that if historical price series of some chosen stocks have a stable relationship in the long run, any deviation from the long run relationships between the assets should be treated as mispricing between these two stocks and it suggests having a long position in the undervalued assets by selling the overvalued one. In this study a market behavioral (market friendly) pairs trading strategy is used to examine the empirical results in IMKB. In this paper there were some risk controls to improve the performance of the strategy. Some restrictions were imposed while choosing the appropriate stocks for pair trading. First of all, we were only interested in stocks whose companies are financially doing well. Secondly, the pairs are formed by the stocks which are operating in the same sector. Thirdly, unlike the classical pair trading strategies, we did not carry positions on the stocks all the time; instead, there were some periods of times that we only held cash but nothing else. When economic climate was not appropriate, we chose to wait in cash. The indicator DI+/DI- was used to check whether economic climate is appropriate for investing in stocks. Moreover, our model was not a static model but a dynamic one. Finally, even though, the return results were significantly good in the market friendly pairs trading strategy, investors should keep in mind that making investment on a stock exchange market carries some risks and it is not possible to build a totally risk-free strategy.

ÖZETÇE

Bu çalışmada market dostu ikili alım satım yöntemi incelenmiştir. İkili alım satımdaki temel düşünce, uzun dönemde birlikte hareket eden iki hisse senedi bulmak ve kısa dönemde bu iki hisse senedinin uzun dönemli ilişkisinde bir bozulma olduğunda bundan faydalanmaktır. İkili alım satımda önemli olan hisse senetlerinin fiyatları değil, fiyatlarının birbirlerine oranıdır. İkili alım satım yöntemi, ikili alım satıma konu olan hisse senetlerinin uzun dönemdeki fiyat oranlarında bir sapma olduğunda, fiyatı çok artmış hisseyi satıp yerine fiyatı geri kalmış hisseyi almamızı böylelikle kar yapmamızı söyler. Bu çalışmada klasik ikili alım satım yöntemleri yerine market dostu ikili alım satım yönteminin IMKB ye etkilerini inceledik. Bu stratejinin performansını artırabilmek için ikili alım satıma konu olacak hisse senetlerini seçerken bazı kısıtlamalar kullandık. Herşeyden önce, sadece finansal açıdan iyi durumda olan şirketlerle ilgilendik. İkincisi, ikili alım satıma konu olacak şirketleri seçerken, mutlaka aynı sektörde faaliyet gösteren şirketler olmasını şart koştuk. Üçüncüsü, klasik ikili alım satım stratejilerinin tersine, her zaman her dakika hisse bulundurmak yerine, zaman zaman tamamen hisse senedi piyasasından çekilip nakitte bekledik. Borsanın çöküş zamanlarını önceden tahmin edebilmek için DI+/DI- indikatörünü kullandık. Son olarak, modelimiz statik bir model değil dinamik bir modeldir. İkili alım satıma konu olan hisse senetlerinin hangileri olduğu modelimizde sürekli güncellenmektedir. Son olarak, bu yöntemle her ne kadar klasik ikili alım satım yöntemlerine göre daha iyi sonuçlar elde ettekse, sermaye piyasalarına yatırım yapmak isteyen kimseler, bu yatırım aracının bazı riskler taşıdığını, ve hiç risk taşımayan mükemmel bir strateji bulmamın mümkün olmadığını bilmelidirler.

TABLE OF CONTENTS

LIST OF TABLES

1. INTRODUCTION

1.1 PAIR TRADING AS A MARKET STRATEGY

Most people have a common interest to find more regular, more stable and most importantly safer ways to manage their investments in the financial markets. Even though everybody agrees on that there is no way to build a totally risk-free strategy, different trading strategies have been subjects of many researches up to now. Pair trading is one of them. The idea in pairs trading is basically to determine the long run relationships between the prices of two financial assets, and take the advantage of the short run deviations from this relationship. Pair trading is based on the idea that if historical price series of some chosen stocks have a stable relationship in the long run, any deviation from the long run relationships between the assets should be treated as mispricing between these two stocks and it suggests having a long position in the undervalued assets by selling the overvalued one.

According the Turkish Central Bank data, a lot of people held dollar instead of TL in the last five years, since they believed that current value of US dollar is undervalued compared to TL. When someone is substituting a financial asset in which he believes it is overvalued (for example TL) with a financial asset in which he believes undervalued (for example US dollars), a pair trading is taking place on this transaction. So, most people around us actually make pairs trading in their daily life. In this paper, we will focus on the usage of pairs trading on stock exchange markets in Turkey other than any financial markets. In different researches, success of the pairs trading can be examined in different financial markets also.

1.2 EMERGENCE OF PAIRS TRADING

The **pairs trade** or *pair trading*, also known as market neutral, was developed in the late 1980s by quantitative analyst and pioneered by Gerald Bamberger while at Morgan Stanley. With the help of others at Morgan Stanley at the time, including Nunzio Tartaglia, Bamberger found that certain securities, often competitors in the same sector, were correlated in their day-to-day price movements. When the correlation broke down, i.e. one stock is traded up while the other is traded down, they would sell the outperforming stock and buy the underperforming one, betting that the "spread" between the two would eventually converge. (http://en.wikipedia.org/wiki/Pairs_trade)

The block trading desk of Morgan Stanley was acting as an intermediary in executing trades on the exchange floor. The block trading desk of Morgan Stanley was executing silent block orders and it was also the risk taking divisions in the equity markets.

In block trading, who decided to clear a large block trade have to manage the risk of losing some spread if they go to the market and post their prices directly. The reason for such a loss is that other players in the market who do not have any information about the total size of the order or the reason for the market price move will not be eager to be in the wrong direction in case of a market jump or crash. There will be lack of counter prices to execute the trade. Therefore, the block trade could not be generally executed at the level that the order is given.

In order to eliminate the probability of loss the institutions were breaking their block trades into a number of smaller trades and trying to execute transactions without losing the liquidity in the market. Or alternatively, the trade was executed through a broker or dealer's block trading desk and the client was avoiding great losses. The only cost for the institution

was the commission paid to the broker, which was negligible compared to the loss probability.

Like all brokers operating in the block trading businesses, Morgan Stanley was facing the problem of how to execute large block of trades efficiently without suffering from the price moves. Once, the block trading desk got the order from a client, the risk of losing from the price movement due to the large size of block trade was lying with the block trade desk.

The block trading desk might have carried the position in the desk's own book, instead of executing the order immediately and bear the risk of losing spread. Alternatively, the desk might have an opposite position that would cover the loss of the block trade in case of an unexpected move in the market prices while executing the block trade. As a result, Morgan Stanley block trading desk analyzed the fundamentals and specifications of the stocks and maintained a list of pairs of stocks those were closely related with other stocks in order to have an alternative for partially hedging positions.

While the block trading desk was implementing the hedging alternative of having opposite positions in similar stocks in executing block trades, a young programmer, Gerry Bamberger, was assigned to work on the equity trading floor to improve the block trading desk's ticket entry process. The volume and profit of the block trading desk were increasing and there existed the necessity of having some re-engineering in operational process to upgrade the business.

While Bamberger was working on the monitoring of the paired hedges as a single entity, he noticed that the stocks in paired hedges had some common behavior trend which made the stocks follow each other. Thus, he began to think of the pairs not as a block to be executed

and its hedge, but as two halves of a trading strategy, which was the first practical attempt investing in stocks in terms of pair trading.

According to Bamberger's hypothesis, each stock can be paired with another stock for a reasonable period of time and only company specific information would make both stocks move away from each other. The relative value of the pair would remain unchanged. However, the company specific effects could easily be diversified away by holding many pairs since they would be independent from one company to another.

With the introduction of "Designated Order Turnaround" (DOT) system, the first electronic execution system in New York stock exchange that enables the execution of the orders electronically, block trading desks gained the ability to execute transaction in a couple of second. Nunzio Tartaglia, who undertook the responsibility of the desk and continued the implementation of the profit opportunity with pair trading after Gerry Bamberger, started an automated trading group at Morgan Stanley with the improved speed of execution.

Profits earned by the traders performing pairs trading strategies in the next years took the attention of both the practitioners and the academicians, and there appeared many studies and applications in the financial markets about pair trading.

Most notable traders used pair trading in different forms in the history. Not only individual traders but also hedge fund industry showed its interest in pair trading. However hedge funds industry was a new face to these strategies and each hedge fund used its own pair trading technique (Ehrman, 2006). The explosion in the hedge fund industry meant that pair trading strategy had a place to stand alone. This caused two different results. First, as each strategy formed the foundation of a given fund, that strategy could be analyzed without the background noise of other trading techniques. A result of this, fundamental analysts,

technicians, and statisticians could each apply their own styles of reasoning to determine whether a given strategy was sound and repeatable. In other words, for the first time, a scientific method could be applied to these methodologies and the results standardized in a format that was widely understood. Standardization is often the precursor of proliferation and, as more traders become interested in these new strategies, an increasing number of them began to appear.

The second result of the hedge fund boom was that as more traders began to study these strategies, using more advanced tools and technologies, the strategies themselves began to be improved and refined (Ehrman, 2006). Strategies that began as a collection of "back-of-the-envelope" analysis evolved into compressive, computer driven systems capable of accounting for the results of millions of calculations per second. In addition to funds themselves, various ancillary services became increasingly advanced. Charting price and fundamental data, and trade execution systems all evolved to meet the changing needs of hedge of the fund managers. The investment industry was experiencing huge growth and inflows of capital; hedge funds were equal participants.

2. LITERATURE REVIEW

Pair trading is one of the Wall Street's quantitative methods of speculation which dates back to mid 1980s. (Vidyamurthy, 2004). The process of pair trading is implemented by identifying pairs of assets whose price tend to move together, and building a trading strategy to gain profits while there is a deviation in this interaction between the asset prices.

With the use of historical descriptive statistics of securities in making trading decisions, many different strategies have been introduced to gain excess profit over classical buy and hold strategies. Being one of these new attempts, pair trading strategy, is mainly built over the Fundamentals of the Notion of co-integration (Engle and Granger, 1987) and the law of one price (Ingersoll, 1987). Besides, basics of the strategy are closely linked to relative value strategies (Jagedeesh and Titman, 1987)

Hogan et al. (2003) empirically investigated whether momentum and value trading strategies constitute statistical arbitrage opportunities by using monthly equity returns of all stocks traded on the NYSE, AMEX and NASDAQ between January 1965 and December 2000. The strategies also have been evaluated in terms of robustness to transaction costs and margin requirements.

While implementing the momentum strategy, they set a formation period and a holding period and they long the top returning stock and sell the lowest returning stock for the formation period and hold this pair during the holding period. The same formation and holding periods are used for the value strategies in pair selection process. However, the criteria to select the stocks to be invested are fundamental characteristics of the companies such as book-to- market, cash flow-to-price, or earning-to-price ratios the holding period. The hypotheses they have tested are that the incremental profits from the strategy must be

statistically greater than zero and time-averaged variance of the strategy must decline to zero as time approaches to infinity.

With momentum strategies, for 14 of the 16 portfolios are evaluated, the point estimate for the mean was greater than zero at 10 percent significance level, and point estimate for the growth rate of variance was less than zero, which were consistent with statistical arbitrage.

In another strategy built with the basics of momentum strategies Larsson et al. (2002) tested a market-neutral arbitrage model using the most liquid stocks from Swedish market over the period 1995 to 2001. The study used momentum techniques to create a list of stocks that exhibit the strongest comovement relationships by forming a ranking among the stocks according to criteria of stocks such as cumulative return during prior six month period, book-to-market ratio magnitude of price changes during the increased in trade volume.

In his research Larsson et al. (2002) has used four main risk controls. First, every time a portfolio was formed, the best four candidates for inclusion were compared and stock that would result in the lowest portfolio risk is picked according to the variance-covariance matrix calculated. Second, the stocks having price lower than 3 Swedish coronas were banned in the model as these stocks were often move in large discrete steps. Third, stop-loss level for a portfolio was set to 20% of the maximum value during the holding period, and final risk control become effective when market to book value has doubled or halved in the last year for more than 4 stocks in a sector. Then the strategy was not implemented in this sector with the expectation that when the valuations deviate too much from the fundamental value, price starts to converge again.

It is concluded with the study of Larsson et al. (2002) that there exist both theoretical and empirical evidences about the improved performance with pairs trading strategies those studies in literature. However, it was mentioned that the results in most academic studies were not based on a methodology realistic enough to measure the performance available to investors in reality.

Suslova and Sudak et al. (2003) carried forward the study of Larsson et al. (2002) and tested his strategy on the European markets by replicating the pairs trading on the Swiss, French, and German and elaborated a portfolio optimization strategy.

The portfolio formed with the model was composed of the two sub portfolios formed on the basis of the cumulative return of the shares during the formation period, while the first sub portfolio was long on the 5 highest returning stocks, the other sub portfolio was short on the five lowest returning stocks. Without analyzing the price movement of the stocks during the trading period, a zero cost portfolios constructed with the ten selected stocks such that the portfolio had the lowest variance between the long and short positions.

The study of Suslova and Sudak et al. (2003) proved that it was possible to outperform the market using behavioral statistical arbitrage strategy and portfolio optimization techniques. The best results were observed in the Swiss market, where the degree of the outperformance of the strategy comparing to the index was the largest compared to French and German markets. While annualized outperformance return over the index of the trading strategy was 21.8% for Swiss market, it was 8.25% in German market and 7.42% in French market. Namely, in Swiss market the strategy performed 21.8% more than the performance of Swiss index itself.

However, Suslova and Sudak et al (2003) made the conclusion that there was no common model of pairs trading strategy that could be applied for all the global markets, since the specifications of the markets, number of active participants and the stocks are the main determinants of the efficiency of any model.

In one of the most reviewed studies about pairs trading in literature, Gatev et al (2006) examined pairs trading strategy for daily stock price data between 1962 and 2002 for U.S. equity market. He selected stocks that were close substitutes according to a minimum distance criterion as pairs.

The first step of the study was normalizing the price series of the stocks by finding the reference point as the first day of the formation period for each stock. Then, he calculated the spread between the normalized price series. The stocks with the minimum deviation had been selected which was determined according to the sum of squared deviations between the stock prices during the pairs formation period.

During the trade period, position was opened with the stocks when prices diverged by more than two historical standard deviations as estimated during the formation period. The position was unwounded at the next crossing of the prices or the last day of the trading period.

A fully invested portfolio of the best five pairs earned an average excess monthly return of 1.31% and a portfolio of the 20 best pairs earned an average excess monthly return of 1.44% per month. They have concluded that these excess returns are large in economical and statistical sense and suggested that pairs trading strategy was profitable.

Although there has been lower profit performance of pairs trading in recent years, Gatev et al. (2006) assigned this situation to increased hedge fund activity. Hedge funds made

use of the profit opportunity as soon as it emerged. They concluded that although raw returns have fallen, the risk adjusted returns have continued to persist.

In another study, Perlin et al. (2007) investigated the profitability and risk of the pairs trading strategy for Brazilian stock market. The data used in the study were categorized in three different frequencies, daily, weekly, and monthly between the periods of 2000 and 2006. The data were normalized and all the price series of the stocks are brought to the same standard unit before a trading period.

It is concluded with the study that the pairs trading strategy was able to beat a properly weighted in naive portfolio in most of the cases. Such result was more consistent for the daily frequency in the interval of the standard deviation threshold of 2. Excessive returns with pairs trading for daily frequency could reach up to 130% with 2 standard deviation threshold.

A multivariate version of pairs trading has also been studied by Perlin et al. (2007) who suggested creating an artificial pair for a stock based on the information on many assets instead of just one. The study was held in Brazilian equity market with daily data from 2000 to 2006 for 57 assets and it is concluded that the multivariate pairs trading was able to beat the market return and random trading alternatives. However, since the model forms an artificial pair with many assets, it was not practical to invest in this artificial pair due to the transaction costs resulting from too many trades to execute for just one trade signal.

The artificial pair was composed of all stocks available in the market by using one of the formation processes: ordinary least squares or correlation weighting, and equal weights. The best performing case was the correlation weighting which yielded 112% total excess return during the trading period. The main conclusion after the profitability analysis was that

the proposed version of pairs trading performs significantly better than the chance and provides positive excessive returns after transaction costs.

There were some pairs trading studies about the Turkish equity market as well. For example, Ozkaynak (2007) conducted a study whose main objective was to verify the performance and risks of pairs trading in Turkish equity market. One of the main conclusions of his study was that pairs trading might be a profitable strategy in Turkish equity market. Such profitability was found consistent over different time frames. Another result of the research was that integrating each stock's fundamentals (P/E, price-to-book ratio, and market capitalization) into the pure quantitative trading strategy improved the testing results.

Another pairs trading strategy about Turkish equity market was conducted by Cetkin (2008). In his study, he analyzed the effects of the pair's selection, threshold level selection, and using bid/ask or low/high prices on the profitability of the strategy in Turkish equity market. The main implication of the study was that the portfolio formed with top five pairs with the lowest deviation between the normalized prices generated positive returns most of the time and had always the highest performance among the alternative portfolios. The only exception that the portfolio ended up in loss was the liquidity crisis scenario where the model used low/high prices for trade execution.

In addition to studies on trading process of the pairs trading strategy, there are some sources in literature aiming to improve the performance of the strategy as a whole. For example, Huck et al. (2008) concentrates on the pair selection process instead of trading model and proposes a new method that uses multiple return forecasts based on bivariate information sets and multi-criteria decision techniques. Using artificial neural networks the method outputs a ranking that helps to detect potentially undervalued and potentially

overvalued stocks. After applying the model to S&P 100 index stocks, the model provided promising results in terms of excess return and directional forecasting.

While the deviation between the paired stocks is detected with purely statistical consideration in the studies of Gatev et al. (2006) and Nath et al. (2003), Do et al. (2006) proposed a general approach to model relative mispricing for pairs trading purposes in a continuous time setting. The relative pricing between two assets is formulated as a continuous time model of mean reversion and with this formulation, the stochastic residual spread is calculated between the pairs. Empirical results of the study showed that mean reversion was captured significantly with the stochastic residual spread model.

In addition to the studies having empirical analysis about pairs trading strategies, there are other sources of reference those only studied of the implementations of the pairs trading without any empirical results. For example, Herlemont et al. (2004) studied the implementation of a pairs trading strategy by investing in stocks those have similar market betas with the expectation of the stock that is bought will outperform the stock that is sold. Herlemont et al. (2004) had some constraints in his trading strategy such as seeking for very low beta differences between the stocks invested in and investing in stocks operating in the same sector. He aimed to build a portfolio which can outperform in terms of excess return with these constraints.

Vidyamurthy et al. (2004) processes for both statistical arbitrage pairs trading and risk arbitrage pairs trading are covered. The statistical arbitrage strategy he implemented is based on cointegration framework, without empirical results. First, the candidate list of potentially cointegrated stock pairs is formed using a distance measure between the stocks. The distance measure is the absolute value of the common factor correlation between the two stocks. Then

the model executes the trades when the predetermined threshold level is breached. The book also discusses various classes of spread dynamics and possible ways to model them.

Although pairs trading strategy is simple and widely implemented by traders and hedge funds, published researches about the subject are limited. Most studies mainly focus on the stock markets and models are generally based on the historical prices of the stocks. It is possible to have studies on European markets and some works on Asian markets as hedge funds activities increase rapidly and since global markets are now more affected from each other it is expected to have more studies on emerging markets such as IMKB in the future.

3.METHODOLOGY

3.1 PAIRS FORMATION

Pair trading is implemented by determining the long run relationships between the historical price series of **two financial assets**, and taking the advantage of the short run deviations from this relationship. Here, emphasis on this definition is two financial assets. There are hundreds of stocks in stock exchange markets. For example in IMKB there are about 330 different stocks. In pairs trading only two of among these 330 stocks are used. So, a simple calculation gives us 54285 (C(330,2)) different possible pairs. Among all these possible combinations, one pair is chosen as an appropriate pair. Different criteria can be used to determine which pair of stocks is an appropriate one. The criterion used in most studies to determine which pair is appropriate for pair trading is whether historical prices of these two assets have a long run correlation or not. If there is a strong correlation between historical price series of these assets, they are mostly considered as an appropriate pair. Namely, in most studies a pure statistical condition such as having a strong long run correlation between historical price series was considered as a good enough criteria.

However, instead of just focusing quantitative analysis of the historical price series of the assets in pair trading, current financial conditions of the companies which are subjects to pairs trading should be considered as well. Interestingly enough, in most researches current financial conditions of the companies are ignored as long as price of one of the assets can be predicted by using the price of the other one. Not paying enough attention to the current financial conditions of the companies is a mistake since making investment on the stock exchange market carries some risks and one of those risks is to lose the all money in one trading day if the company goes bankruptcy. Therefore a good investment strategy must take

into account the financial conditions of the companies which are subject to pairs trading as well instead of just focusing statistical relationships of the historical price series. There were some companies in IMKB which used to exist in the past but no longer exist.

ABANA ELEKTROMEKANİK SANAYİ VE TİCARET A.Ş.	04.03.1992
ALFA MENKUL DEĞERLER A.Ş.	01.10.1998
ARAT TEKSTİL SANAYİ VE TİCARET A.Ş.	06.11.1997
EGS HOLDİNG A.Ş.	30.03.2000
EGS EGESER GİYİM SANAYİ İÇ VE DIŞ TİCARET A.Ş.	03.07.1997
KONİTEKS KONFEKSİYON ENDÜSTRİ VE TİCARET A.Ş.	03.08.1993
LİO YAĞ SANAYİİ VE TİCARET A.Ş.	02.03.2000
MEDYA HOLDİNG A.Ş.	09.06.1992
MEGES BOYA SANAYİ VE TİCARET A.Ş.	09.05.1997
RAKS ELEKTRONİK SANAYİ VE TİCARET A.Ş.	09.08.1993
RAKS ELEKTRİKLİ EV ALETLERİ SANAYİ VE TİCARET A.Ş.	20.12.1994
SABAH YAYINCILIK A.Ş.	10.05.1990
SABAH PAZARLAMA A.Ş.	23.03.1994
ÜNAL TARIM ÜRÜNLERİ İHRACAT VE SANAYİ A.Ş.	29.08.1997

Table 3.1.1 Companies de-listed from the market permanently

Source: http://www.imkb.gov.tr/imkbweb/Home.aspx

So, in this research, instead of just focusing on the pure statistical relationship between the historical price series of the stocks, current financial conditions of the companies are considered as well. There are different criteria to measure of the healthiness of the current financial conditions of a company. One of these criteria is to look at how much profit the company makes. However, evaluating companies according to their profitability might be misleading. For example, a company which is suffering from severe financial problems can temporarily make a positive profit in an accounting period by selling its properties and providing hot money. There used to be firms in XU100, which made profit for just one period, and the next period losses of these companies were even larger.

Another problem with measuring the profitability of the companies is that a firm can make a loss in an accounting period because it spends a lot of money to make huge investments. Positive outcomes of these investments may appear in the future accounting periods instead of the current one. A company which makes loss due to its investments can make huge profits in the future accounting periods. So, looking profitable is not a good idea to check the healthiness of financial conditions of a company since measuring profit is complicated and misleading. A man who has just sold his car can carry large amount of cash for a period of time, but that does not necessarily mean that he is performing well in his financial world. The money came from selling a property, a car for example. Namely, somebody who has just bought a new house may experience a shortage of cash for some period of time, but in the future he can enjoy positive consequences of buying a house. Companies are alike too.

In my research, I used companies' owners' equities instead of profits to determine financial performance of the firms. If a company makes profit, the owner's equity of the company gets larger. If a company makes a loss, owner's equity of the company gets smaller, so, owner's equity takes into account the profits but also a company's owner's equity can get larger when it spends its cash to make new investments. Therefore, owner's equity is a better measurement criterion to measure financial healthiness of a company since it both takes into account the profit and the money spent on investments. In the table at the appendix 8.1, companies are listed according their owners' equities amounts

In his pair trading strategy, Herlemont et al. (2004) had some pair formation constraints such as investing in stocks operating in the same sector. In this study, we have used the same constraint as well. Some researchers argued that stocks subject to pair trading can be chosen from different sectors as long as there is a strong long run correlation between

the historical price series of the stocks. Two stocks may have a close comovement relationship for a period of time; however, this relationship can break down permanently by some sector specific news. So, actually, investing in stocks operating in the same sector is a kind of risk control. By choosing the stocks from the same sector, we try to prevent a breakdown of the statistical relationship due to some sector specific news. In IMKB, there are three main sectors and each of these sectors is consisting of some subsectors.

CODE	INDICE	SUB-SECTOR INDICES
XUSIN	ISE NATIONAL INDUSTRIALS	FOOD, BEVERAGE, TEXTILE, LEATHER, WOOD, PAPER, CHEMICAL, BASIC METAL, MACHINERY
XUMAL	ISE NATIONAL FINANCIALS	BANKS, INSURANCE, LEASING, FACTORING, HOLDING AND INVESTMENT
XUHIZ	ISE NATIONAL SERVICES	ELECTRICITY, TRANSPORTATION, TOURISM, WHOLESALE, TELECOMMUNICATIONS, SPORT

Table 3.1.2 Sub-sector indices in XU100

As a result, this study has two risk controls on pair formation process. First, companies with the highest owners' equities are chosen as pairs to make sure that companies whose stocks are subject to pairs trading are financially healthy. Secondly, companies are chosen from the same sector to slip away the effects of sector specific news.

3.2 TRADING RULES

Pair trading is implemented by determining the long run relationships between the historical price series of two financial assets, and taking the advantage of the **short run deviations** from this relationship. Here the emphasis is on this definition is short deviations. Many researches agreed on that as the two stocks have a close comovement relationship and this relationship does not break down permanently during the trading period, the strategy with the chosen pairs gives high rates of return. A researcher who is conducting his research currently has the all information about the past price series of financial assets. This researcher may set up a methodology which fits the past data perfectly; however, a methodology is good enough only if it continues its high performance as the new data keeps on coming. So, at that point there is another crucial question: When there is a significant deviation in the long run relationships of the prices of the stocks during the trading period, how does anyone understand the distinction between whether this deviation is a temporary short run deviation or a permanent long run breakdown of the long run correlation?

Unfortunately this distinction is not explained at all in the any of the past researches. Instead, it is mentioned as one of the potential risks which must be taken into account by investors who are already willing to make investment on such a risky field as stock exchange market. Here, we need to develop a method to understand when there is a significant deviation from the long run correlation whether this deviation is a temporary short run deviation which eventually disappears or a permanent long run breakdown of the long run correlation which causes the strategy end with a loss. In my research an indicator called DI+/DI- will be used to understand the distinction between those two.

3.2.1 Directional Movement Index (DI+/DI-)

DMI filtrates on price exchange rates lays in the basis and lets enter the market only if substantial trends exist. It is developed for increasing the strength of all upward or downward trends in the stock markets. The **Directional Movement Index** consists of Average Directional Index, or ADX, which defines the strength of the trend and DI+ and DI- which demonstrate the strength of the decreasing and increasing prices correspondingly. ADX is a moving average of Directional Index, or DX, with a smoothing constant makes time period selected for calculating upward and downward fluctuations twice as long.

Parameters:

1. N - the period of averaging

Calculation:

1. Calculation of the **positive and negative directional movement** - DM - $+DM_j$ and $-DM_j$

if $High_j > High_j - 1$, $+DM_j = High_j - High_j - 1$, differently $+DM_j = 0$

if $Low_j < Low_{j-1}$, $-DM_j = Low_{j-1} - Low_j$, differently $-DM_j = 0$

Smaller value from $+DM_j$ and $-DM_j$ is equated to zero. If they are equal, both are equated to zero.

2. Calculation of the true range- TR_j

$TR_j = \max (|Low_j - Close_{j-1}|, |High_j - Close_{j-1}|, |High_j - Low_j|)$

3. Calculation of a **positive directional index** and the **negative directional index** - $+DI_j$ and $-DI_j$

If $TR_j = 0$, $+SDI_j = 0$, $-SDI_j = 0$,

if TR_j 0, $+SDI_j = +DM_j / TR_j$; $-SDI_j = -DM_j / TR_j$

Smoothing +SDI and -SDI by exponentional moving average (EMAve), we receive $+DI_j$ and $-DI_j$

$+DI_j = EMAve_j (+SDI, N)$

$-DI_j = EMAve_j (-SDI, N)$

4. Calculation of the directional movement - DX_j:

$DX_j = (| +DI_j --DI_j | / | +DI_j +-DI_j |)$

In a trading system with DMI in the centre, there is a purchase signal when the DI+ value overcomes the DI-, and for a sell signal, search the point in which DI exceeds DI+. Both trading signals are given only if there is a rather strong trend. For instance, when the DI+ rises above DI- it is a clear purchase signal. In pairs trading, we trade two stocks simultaneously. Whenever we sell one stock, we buy the other one. So, we need a technical indicator which can give us information about the prices of the both stocks at the same time. Namely, we need to know the price movements of the stock we have in hand and also we need to know the price movements of the stock which we follow but do not have for the moment. The indicator DI+/DI- has two components, which are DI+ and DI-. DI+ gives us information about the price movements of the stock we have in hand, and DI- gives us information about the price movements of the stocks we follow. That is why we chose the indicator DI+/DI- as the ruling indicator, but not any other indicators. When we check the DI+/DI- we are able to check the price movements of the both stocks simultaneously.

3.2.2. Choosing Initial Pairs

First of all, two companies are chosen from the each sector. Namely, two companies from XUSIN, two other companies from XUMAL, and finally two other companies from XUHIZ are chosen. As it is mentioned before, in this study, owner's equity is used to choose appropriate pairs. Therefore, for each sector, the first two companies with the largest owner's equity are chosen. The table below summarizes the companies with the greatest owners' equities in each year for each sector.

SUBSECTOR INDICES	COMPANY CHOSEN	OWNER'S EQUITY	COMPANY RESERVED	OWNER'S EQUITY
XUSIN	EREGL	4,801,000,000 TL	TUPRS	3,252,500,000 TL
XUHIZ	TTKOM	7,690,000,000 TL	TCELL	4,771,000,000 TL
XUMAL	ISCTR	9,677,000,000 TL	SAHOL	6,799,000,000 TL

Table 3.2.2.1 First two companies with the highest owners' equities from each sector in 2005

SUBSECTOR INDICES	COMPANY CHOSEN	OWNER'S EQUITY	COMPANY RESERVED	OWNER'S EQUITY
XUSIN	EREGL	5,399,000,000 TL	TUPRS	3,461,000,000 TL
XUHIZ	TTKOM	6,410,000,000 TL	TCELL	5,557,000,000 TL
XUMAL	ISCTR	9,410,000,000 TL	AKBNK	7,065,000,000 TL

Table 3.2.2.2 First two companies with the highest owners' equities from each sector in 2006

SUBSECTOR INDICES	COMPANY CHOSEN	OWNER'S EQUITY	COMPANY RESERVED	OWNER'S EQUITY
XUSIN	EREGL	6,004,000,000 TL	TUPRS	4,111,000,000 TL
XUHIZ	TCELL	6,670,000,000 TL	TTKOM	6,122,000,000 TL
XUMAL	ISCTR	10,603,000,000 TL	AKBNK	10,600,000,000TL

Table 3.2.2.3 First two companies with the highest owners' equities from each sector in 2007

SUBSECTOR INDICES	COMPANY CHOSEN	OWNER'S EQUITY	COMPANY RESERVED	OWNER'S EQUITY
XUSIN	EREGL	5,936,000,000 TL	ENKAI	4,961,000,000 TL
XUHIZ	TCELL	8,084,000,000 TL	TTKOM	5,113,000,000 TL
XUMAL	AKBNK	11,208,000,000 TL	KCHOL	9,750,000,000 TL

Table 3.2.2.4 First two companies with the highest owners' equities from each sector in 2008

3.2.3. Trades for XUSIN Indices

For example, as long as XUSIN is concerned, according to data in 31.12.2005, EREGL has the greatest owner's equity with 4,801,000,000 TL among all companies belonged to XUSIN indices and TUPRS has the second greatest owner's equity according to data in 31.12.2005. (table 3.2.2.1)

EREGL, as having the largest owner's equity is called "the chosen stock" whereas TUPRS, as having the second largest owner's equity is called "reserved stock". First day of the trading period is 01.01.2006. At the beginning of the market opening, we buy the "chosen stock", namely EREGL in this case since it has the greatest owner's equity. After that time, we pay attention only to EREGL and TUPRS. When a new signal comes from our indicator DI+/DI- we will change the pair, we will sell EREGL and buy TUPRS. As long as DI+ is greater than DI-, the indicator tells us to keep the chosen stock we have. When DI- rises above DI+, we will sell the chosen stock (EREGL) and buy the reserved stock (TUPRS). The table below shows the summary of trades.

DATE	DI+	DI-	SIGNAL	PRICE	SIGNAL	PRICE	RETURN	100 TL BECOMES
03.02.2006	22,04	21,3	BUY EREGL	3,36				
17.04.2006	17,76	28,31	SELL EREGL	3,17	BUY TUPRS	16,71	-5,65%	94,35
11.09.2006	22,72	19,95	BUY EREGL	2,9	SELL TUPRS	18,82	12,63%	106,26
24.12.2007	18,23	19,06	SELL EREGL	7,2	BUY TUPRS	24,97	148,28%	263,83
03.03.2008	18,68	16,49	BUY EREGL	6,16	SELL TUPRS	23,46	-6,04%	247,9
01.09.2008	22,5	22,7	SELL EREGL	7,75	BUY TUPRS	23,89	25,81%	311,86
17.11.2008	23,78	17,21	BUY EREGL	4,06	SELL TUPRS	13,17	-44,87%	171,94
02.03.2009	18,48	21,73	SELL EREGL	3,48	BUY ENKAI	4,1	-14,29%	130,35
22.06.2009	20,38	19,96	BUY EREGL	4,4	SELL ENKAI	4,74	15,61%	150,7

Table 3.2.3.1 Return table of the trades for XUSIN.

In 17.04.2006 for the first time, DI - gets greater than DI+, as long as this happens during the trading day, we immediately sell EREGL at its current price and we buy TUPRS

instead. We keep TUPRS as long as DI- is greater than DI+. In 11.09.2006, DI+ rises above DI- again, which is a signal to sell TUPRS and buy the EREGL back. In 24.12.2007 DI- gets greater than DI+ again, which is a signal to sell EREGL and buy TUPRS back. As it is understood, whenever DI+ gets greater than DI- we buy the "chosen stock" back and keep it as long as DI+ is greater than DI-. If anytime DI- gets greater than DI+ we sell the "chosen stock" and buy the reserved stock back. This process continues unless one of the "chosen stock" and "reserved stock" changes. Note that we call the stock with the highest owner's equity as the "chosen stock" and the stock with the second highest owner's equity is called as "reserved stock".

So according data in 31.12.2008, EREGL has still the highest owner's equity but now ENKAI instead of TUPRS had the second highest owner's equity. Therefore "chosen stock" is still EREGL but, the reserved stock changed from TUPRS to ENKAI. After this time pair trading will be taking place between EREGL and ENKAI. That means the portfolio is not a static portfolio but a dynamic one. At the end of each year, current values of owner's equity are announced and if there is difference in the order of the companies the methodology takes this into account also. For example, between 2005 and 2007 EREGL and TUPRS are the first two companies with the highest owners' equities, therefore, pair trading is taking place between these two companies, however, in 2008 EREGL and ENKAI are the first two companies with the highest owners' equities (table 3.2.2.4.), therefore, pair trading is taking place between these two companies now.

We can repeat the same experiment for XUMAL also.

3.2.4. Trades for XUMAL Indices

As long as XUMAL is concerned, according to data in 31.12.2005, ISCTR has the greatest owner's equity with 9,677,000,000 TL among all companies belonged to XUSIN indices and SAHOL has the second greatest owner's equity with 6,799,000,000 TL according to data in 31.12.2005. (table 3.2.2.1)

ISCTR, as having the largest owner's equity is called "the chosen stock" whereas SAHOL, as having the second largest owner's equity is called "reserved stock". First day of the trading period is 01.01.2006. At the beginning of the market opening, we spent all our money to buy the "chosen stock", namely ISCTR in this case. After that time, we pay attention only to ISCTR and SAHOL. When a new signal comes from our indicator DI+/DI- we will change the pair, we will sell ISCTR and buy SAHOL. As long as DI+ is greater than DI-, the indicator tells us to keep the chosen stock. Once, DI- becomes greater than DI+ we will sell the chosen stock (ISCTR) and buy the reserved stock (SAHOL). The table below shows the summary of trades.

DATE	DI+	DI-	SIGNAL	PRICE	SIGNAL	PRICE	RETURN	100 TL BECOMES
02.01.2006			BUY ISCTR	6,73				
23.01.2006	17,59	18,25	SELL ISCTR	7,37	BUY SAHOL	5,28	9,5%	109,5
15.05.2006	21,29	15,33	BUY ISCTR	5,83	SELL SAHOL	4,98	-5,68%	103,28
30.04.2007	17,33	18,77	SELL ISCTR	5,77	BUY AKBNK	7,10	-1,02%	102,23
01.10.2007	20,14	17,06	BUY ISCTR	5,94	SELL AKBNK	8,70	22,53%	125,26
23.06.2008	18,08	25,63	SELL ISCTR	4,14	BUY AKBNK	4,62	-30,3%	87,31
18.08.2009	16,38	19,79	BUY KCHOL	3,50	SELL AKBNK	7,95	72,07%	150,23

Table 3.2.4.1 Return table of the trades for XUMAL

3.3 RETURN CALCULATION

In table above, we have returns as percentage and a cumulative return which shows how a portfolio of 100 TL changed up to now. To calculate the returns as percentage the following formula is used.

Percentage Return = (Ps-Pb)/Pb   where;

Ps: Current market price of the stock when it is sold

Pb: Current market price of the stock when it is bought

For example, at 03.03.2008 we bought EREGL at a price of 6,16. This price is Pb. And at 01.09.2008 we sold EREGL at a price of 7,75. This price is Ps. So,

Percentage Return = (Ps-Pb)/Pb = (7,75-6,16)/6,16 =0,2581 or 25,81%

3.4 PAIR TRADING WITH MARKET CONSIDERATIONS

In most studies, pair trading is considered as a market neutral strategy. Namely, traders do not bet on the direction of the market. However, current economic conditions of a country have great effects on the stock exchange market. For example, in the past when there was an economic crisis in 1999, values of all stocks (without any exception) decreased. So, if somehow we can determine these long break downs, we may prevent our portfolio from losses. For example, in this study, we applied pairs trading strategy between EREGL and TUPRS and later between EREGL and ENKAI between 2006 and 2009, as a result, 100 TL became 150,7 TL in three years. However, there were some transactions at which percentage returns were negative. For example, 01.09.2008 and 17.11.2008, our portfolio made a 44,87% loss. If we take into account the market conditions, performance of the strategy may increase.

So, before investing in any stock, we first set up an alert system which continuously tells us whether the current economic climate is appropriate to make investment or not. If current economic climate is not appropriate, we sell all the stocks we have immediately and hold cash until a signal which tells us that current economic climate is appropriate to make investment again. We will run the same pairs trading example once more but this time an alert system about IMKB is used as well.

The alert system is simple. We again use the indicator DI+/DI- because of the reasons I mentioned above to check whether current economic climate is appropriate or not. If DI+ is greater than DI-, that means we are allowed to make investments, if DI- is greater than DI+, we will sell all the stocks immediately and begin to hold cash until DI+ becomes greater than DI- again. The table below summarizes the appropriate periods to make investment in stocks.

DATE	DI+	DI-	SIGNAL	UNTIL	DURATION
20.06.2005	20,2	18,52	ENTER	15.05.2006	330
15.05.2006	21,48	28,89	OUT	16.10.2006	152
16.10.2006	24,3	22,06	ENTER	19.11.2007	398
19.11.2007	24,87	26,08	OUT	06.04.2009	138
06.04.2009	24,87	23,75	ENTER	CURRENT DAY	140

Table 3.4.1 Signals for IMKB IN and IMKB OUT generated by DI+/DI-

For example, we began pairs trading by buying EREGL at the beginning of the trade period. At 15.05.2006 DI- becomes greater than DI+, which means an IMKB out signal. Therefore, as soon as we see this signal during the trading period, we sell our current stocks and begin to hold cash until 16.10.2006. At 16.10.2006, an IMKB enter signal is generated by the DI+/DI- indicator. At 16.10.2006, DI+ becomes greater than DI- again after 152 days later. So, we will spend our current cash to by the chosen stock (the one with the highest owner's equity) again. The only difference is there is an on/off alert system here which means

we do not have a stock all the time. In classical pairs trading, traders hold stock every moment of every day. Whenever they sell a stock, they buy the other one back. However, in this study, we may hold the "chosen stock" or we may hold the "reserved stock" or we may not have any stocks at all for some period of time. The table below summarizes a market behavioral pairs trading strategy.

DATE	DI+	DI-	SIGNAL	PRICE	SIGNAL	PRICE	RETURN	100 TL BECOMES
03.02.2006	22,04	21,3	BUY EREGL	3,36				
17.04.2006	17,76	28,31	SELL EREGL	3,17	BUY TUPRS	16,71	-5,65%	94,35
15.05.2006	OUT	OUT	OUT	2,85	OUT	17,52	4,85%	98,92
16.10.2006	IN	IN	IN		IN			
16.10.2006	37,176	15,76	BUY EREGL	3		16,88		
19.11.2007	OUT	OUT	OUT	7,48	OUT	23,65	149,30%	246,62
06.04.2009	IN	IN	IN		IN			
06.04.2009	26,22	31,99		3,3	BUY ENKAI	4,08		
04.05.2009	18,213	16,443	BUY EREGL	3,94	SELL ENKAI	4,68	14,70%	282,88

Table 3.4.2 Pairs trading as a market behavioral strategy

At 17.04.2006 DI- becomes greater than DI+ therefore, we sell EREGL and buy TUPRS with the all money. At 15.05.2006 an IMKB out signal is generated by DI+/DI- (check table 3.4.1), so we sell TUPRS but by nothing, instead we hold cash until a IMKB IN signal is generated by DI+/DI-. At 16.10.2006 an IMKB IN signal is generated, so we spend all our cash and invest in EREGL. At 16.10.2006 we invested in EREGL not TUPRS because at that date DI+ is greater than DI-. We keep EREGL until 19.11.2007 since a new IMKB OUT signal is generated (check table 3.4.1). so, we sell all the stocks and begin to hold cash again. At 06.04.2009 A new IMKB IN signal is generated by DI+/DI- (check table 3.4.1). Therefore we spend all our cash and make an investment in ENKAI stocks. At 06.04.2009 we invested in ENKAI stock but not EREGL since at that date DI- is greater than DI+.

As a result, by allowing an alert system for IMKB IN/IMKB OUT performance of the strategy increased significantly.

4. CONCLUSION

Pair trading is used as a market strategy by many researchers and academicians and even by some hedge funds up to now. Almost each of them used his own version of pairs trading strategy. In this study a market behavioral (market friendly) pairs trading strategy is used to examine the empirical results in IMKB. In this paper there were some risk controls to improve the performance of the strategy. Some restrictions were imposed while choosing the appropriate stocks for pair trading.

First of all, we were only interested in stocks whose companies are financially doing well. In order to understand the current financial conditions of the companies we used their current owners' equities. Secondly, the pairs are formed by the stocks which are operating in the same sector. By choosing stocks from the same sector, we aimed that sector specific information would make both stocks affect so; the relative value of the pair would remain unchanged. Thirdly, unlike the classical pairs trading strategies, we did not carry positions on the stocks all the time; instead, there were some periods of times that we only held cash but nothing else. Sometimes we held positions on the stocks, sometimes we held only cash. When economic climate was not appropriate, we chose to wait in cash. Finally, our model was not a static model but a dynamic one. At the end of each year current values of owners' equities of the companies are updated. So, if there is a change in the order of the owners' equities, we change the stocks accordingly. The table 8.1 shows how owner's equities of the companies changed each year.

As a result, by using this market friendly, dynamic pairs trading technique, we were able to achieve quite good results. Studies about the pairs trading are limited and most of them are done by examining the stock exchange markets of the developed countries. More and

more researchers are getting interested in pairs trading in each day. So, in the future there may be more pairs trading studies on the stocks of the emerging markets such as IMKB as well. Finally, even though, the return results were significantly good in this dynamic, market friendly pairs trading strategy, investors should keep in mind that making investment on a stock exchange market carries some risks and it is not possible to build a totally risk-free strategy.

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6. APPENDIX

Owners' Equities of the Companies in IMKB (TL) (from smallest to largest)

Hisse	2005/12	2006/12	2007/12	2008/12
DARDL E	-191.165.802	-243.600.503	-207.831.898	-286.672.449
ZOREN E	311.408.675	285.779.429	273.380.013	-81.820.907
CBSBO E	-35.037.760	-47.535.458	-47.633.756	-72.294.787
MZHLD E	-11.187.547	-19.187.474	-20.959.190	-31.721.617
KERVT E	-15.821.880	-24.127.041	-11.354.044	-28.529.775
TRNSK E	23.018.118	23.226.958	10.771.811	-28.426.300
EPLAS E	694.407	-8.834.956	-8.226.226	-27.374.725
BERDN E	4.072.244	-15.773.466	-23.048.676	-24.854.266
MAKTK E	22.884.187	20.313.985	-63.695.897	-21.748.645
EMKEL E	922.141	-1.968.316	-1.991.451	-1.579.225
ISATR E	4.915	3.414	3.847	3.428
ISBTR E	142.535	98.997	111.555	99.406
TKSYO E	-	2.291.255	1.977.911	1.075.218
METYO E	-	2.543.633	2.926.859	1.313.213
CEYLN E	7.002.303	7.533.513	8.295.885	1.903.617
EVNYO E	3.423.644	3.386.402	3.435.134	2.027.993
MERKO E	16.118.307	15.721.262	12.019.274	2.081.220
BISAS E	13.278.073	2.164.254	1.791.793	2.464.424
MRTGG E	8.860.745	7.678.367	6.422.539	2.678.964
MYZYO E	3.464.796	5.527.937	6.455.342	2.730.791
MZBYO E	-	3.148.053	2.866.611	2.784.980
AVRSY E	7.139.913	5.396.031	6.564.688	2.859.277
HDFYO E	3.034.522	3.336.401	3.594.199	3.091.373
INFYO E	3.509.059	4.098.345	4.408.650	3.091.434
ESEMS E	3.977.130	-1.150.758	8.255.324	3.121.606
ATLAS E	4.447.689	5.353.361	7.616.309	3.165.527
ATSYO E	6.511.748	9.531.497	11.721.088	3.553.758
DURDO E	8.884.326	10.201.718	6.848.395	3.688.482
MRBYO E	-	3.091.260	3.627.421	3.795.682
TCRYO E	-	4.949.966	5.048.924	3.865.119
VKFRS E	10.652.862	4.233.797	4.174.825	4.502.652
FRIGO E	10.817.391	10.153.340	8.901.965	4.509.720
METUR E	13.689.815	13.385.066	12.433.338	4.715.946
BSKYO E	-	2.712.373	4.996.693	4.717.776
BURVA E	8.036.301	7.676.374	5.979.840	4.931.480
BJKAS E	37.145.901	18.945.338	22.634.782	5.090.355
IBTYO E	5.597.952	4.968.907	5.526.152	5.290.564

ETYAT E	-	-	5.168.898	5.426.332
BUMYO E	3.639.825	6.066.442	6.750.082	5.581.038
GDKYO E	3.227.160	5.500.868	8.465.693	5.941.977
LINK E	9.131.133	8.031.048	6.314.472	6.548.638
BROVA E	11.524.479	9.637.415	7.711.083	6.686.566
ATAYO E	3.784.016	3.999.526	9.515.246	7.181.123
SELGD E	17.126.819	21.191.958	11.897.605	7.297.507
VKING E	35.262.738	23.667.857	23.978.150	7.317.326
BURCE E	9.098.002	8.067.478	7.441.244	7.490.601
TACYO E	9.204.063	9.854.128	12.232.243	7.920.439
MTEKS E	15.943.827	10.386.119	13.926.198	8.099.218
SERVE E	7.364.434	8.182.969	9.339.777	8.136.337
OYAYO E	-	10.230.198	10.958.614	8.343.995
INTEM E	28.016.471	22.923.406	24.301.379	9.197.293
VARYO E	4.499.105	4.874.914	8.659.798	9.387.031
EMNIS E	17.997.828	17.360.370	16.442.749	9.508.568
EGCYO E	11.789.706	7.914.961	19.832.823	9.606.998
EMBYO E	-	3.077.994	10.012.670	10.021.523
BFREN E	22.222.882	22.541.424	23.666.476	10.143.537
YTFYO E	7.395.696	12.270.203	14.359.738	10.648.045
LUKSK E	12.247.252	13.099.896	12.219.230	11.035.954
DOGUB E	21.639.788	8.865.683	7.602.978	11.080.516
VKFYT E	11.644.185	11.875.817	14.103.333	11.547.073
OZGYO E	5.412.437	6.123.323	9.138.696	11.729.307
IDAS E	35.702.943	33.232.839	32.955.093	11.821.669
ALYAG E	10.031.547	11.979.574	11.705.876	11.990.617
AFMAS E	23.213.271	21.046.488	21.173.980	12.157.341
DERIM E	7.554.668	10.324.511	12.390.818	12.247.906
HZNDR E	9.923.266	12.790.279	13.727.386	12.772.475
OKANT E	10.206.536	8.904.331	8.415.676	13.074.592
PKENT E	17.739.713	13.796.574	10.359.110	13.105.553
SKPLC E	20.491.468	21.056.499	38.042.544	14.039.225
TIRE E	82.542.977	82.397.255	79.360.596	14.727.349
KNFRT E	9.228.985	11.496.124	17.793.992	15.499.238
SEKFK E	-3.771.566	-6.038.124	7.819.963	15.819.481
FNSYO E	23.430.975	24.730.857	28.197.301	16.390.844
KLBMO E	-15.892.930	-4.989.866	15.519.334	16.795.313
DGATE E	5.696.210	13.898.085	16.845.566	17.107.889
GEREL E	12.396.798	14.073.856	14.639.533	17.188.299
TSKYO E	17.671.867	20.017.652	22.149.149	18.167.716
GRNYO E	9.139.060	18.904.054	24.049.149	20.021.305
ESCOM E	20.868.197	21.079.314	21.316.757	20.293.844
ERSU E	23.272.034	20.708.327	20.851.964	20.687.057
USAK E	23.533.652	21.833.766	23.172.650	21.148.845

ARMDA E	10.295.000	19.750.000	19.078.310	21.897.047
ECBYO E	22.301.461	21.036.361	27.064.781	22.032.032
AKIPD E	69.749.524	53.930.218	45.949.464	22.740.846
GEDIZ E	9.877.823	8.412.586	25.765.375	23.339.670
YYGYO E	31.385.014	27.744.662	26.304.509	24.153.895
PKART E	22.954.916	21.954.995	22.466.337	24.191.130
PRTAS E	26.362.823	22.477.200	23.565.606	24.472.568
DENCM E	28.161.784	28.938.129	27.141.361	25.317.615
KLMSN E	26.069.269	31.890.171	32.654.762	26.027.542
DITAS E	26.894.299	27.640.454	27.111.493	26.138.918
ARFYO E	20.219.852	30.690.602	37.480.031	28.549.498
TUKAS E	67.073.778	55.637.249	43.299.819	28.809.751
KAPLM E	29.862.787	32.045.859	32.512.538	31.137.924
FMIZP E	17.768.899	22.374.052	19.147.210	31.610.694
SILVR E	12.210.120	33.762.636	32.306.193	31.670.041
CMBTN E	32.433.646	35.231.438	37.667.084	31.823.711
FVORI E	79.187.031	60.717.307	68.029.073	32.074.457
MIPAZ E	21.505.796	23.582.751	20.473.756	32.168.927
AKSUE E	25.285.602	25.798.511	26.178.234	32.276.416
TEKTU E	38.056.700	35.729.467	33.712.369	32.335.995
CELHA E	25.673.019	28.201.942	28.815.011	34.173.767
EDIP E	69.948.014	55.969.757	53.159.916	34.325.472
BRMEN E	47.319.742	49.986.463	50.934.206	35.132.785
LOGO E	33.301.349	30.170.933	37.396.296	36.205.293
KRSTL E	38.948.769	38.712.646	38.889.476	36.437.828
PENGD E	35.466.785	20.783.960	28.088.040	37.015.527
VAKFN E	29.724.000	36.367.000	32.985.000	37.240.000
AKYO E	48.859.654	50.419.234	51.971.879	37.809.322
TEKFK E	23.726.281	27.745.363	32.008.171	38.750.591
DOBUR E	34.165.926	34.492.546	39.760.140	38.983.562
EGEEN E	28.771.593	38.013.474	36.537.888	39.481.413
DNZYO E	25.138.915	36.322.208	46.827.540	40.148.271
MAALT E	51.659.015	45.212.297	41.397.405	40.306.599
GARFA E	24.025.173	28.622.110	34.346.135	41.427.917
ARENA E	26.381.019	33.650.375	34.442.115	42.555.510
FENIS E	29.711.845	33.510.765	36.466.061	43.415.960
CRDFA E	27.391.933	29.028.830	35.755.999	45.512.674
ALCTL E	24.119.797	31.493.694	30.533.968	45.610.784
ERBOS E	26.197.020	36.458.307	45.448.345	45.954.078
MEMSA E	15.005.380	87.601.254	68.986.834	45.999.319
DYOBY E	49.519.426	38.814.343	80.365.746	48.829.110
ADEL E	29.622.720	36.243.952	39.916.725	49.407.278
YUNSA E	69.706.590	75.276.826	72.451.087	50.024.929
SAGYO E	-24.630	7.115.158	58.952.984	50.299.085

YATAS E	47.013.799	51.343.383	54.807.802	51.266.486
BOYNR E	-1.821.398	37.208.897	51.248.765	51.404.871
VANET E	24.841.896	24.628.465	24.417.751	52.504.908
BAKAB E	39.369.546	48.790.484	51.401.895	53.479.721
NUGYO E	37.062.115	40.903.010	47.473.879	53.535.544
YKRYO E	44.079.245	48.296.706	60.001.543	53.878.386
AFYON E	34.557.888	44.755.833	53.638.156	54.989.869
DENTA E	69.931.756	80.367.577	88.620.775	55.144.057
SONME E	89.369.247	78.583.399	69.083.476	55.381.239
NTTUR E	55.548.883	53.734.124	145.025.960	56.233.154
CYTAS E	39.300.072	53.092.122	52.865.665	60.906.463
ANELT E	54.557.618	52.384.791	64.239.682	61.147.970
PINSU E	39.611.558	48.842.044	56.426.200	61.326.279
DESA E	63.207.242	59.662.177	65.610.842	62.214.816
RAYSG E	21.909.315	16.195.692	49.079.916	62.244.087
KARSN E	57.842.645	46.885.877	108.198.544	64.812.240
PIMAS E	23.299.552	31.878.480	69.748.582	66.435.273
DMSAS E	68.495.178	70.397.825	69.915.100	70.498.906
VKGYO E	52.981.880	57.504.072	62.701.299	70.814.308
SNPAM E	95.443.280	90.983.886	102.778.543	72.119.885
KRTEK E	63.103.455	64.298.686	68.314.931	73.025.210
TBORG E	62.746.844	-1.058.068	10.774.749	78.554.567
AYCES E	68.637.318	63.886.538	74.715.998	78.752.351
UCAK E	82.841.796	152.172.442	56.929.050	79.031.577
HEKTS E	66.118.749	71.465.617	76.471.888	79.256.872
KAREL E	33.378.968	62.309.312	70.398.584	79.539.402
TSPOR E	35.774.555	42.512.529	70.429.570	81.768.064
ARSAN E	119.593.846	115.777.825	105.338.987	84.019.128
ISAMB E	-3.322.369	20.404.876	32.498.341	85.306.093
BANVT E	83.638.116	96.925.873	152.449.322	85.811.277
KUTPO E	84.238.454	85.026.648	85.263.783	86.692.903
EGYO E	83.737.467	79.065.957	87.591.894	86.916.702
FENER E	65.590.727	73.294.513	72.682.053	87.576.012
EGPRO E	63.546.046	73.855.082	89.308.720	87.837.397
INDES E	61.486.266	73.878.261	86.221.286	88.088.902
PEGYO E	37.891.049	32.459.186	72.745.944	90.256.113
KRDMB E	34.495.894	44.909.656	53.473.293	90.290.946
MARTI E	89.031.508	93.041.615	90.251.958	91.145.400
IHEVA E	32.771.393	33.976.702	80.734.021	93.323.015
GENTS E	65.377.082	79.816.664	88.983.386	93.808.899
TUDDF E	175.947.357	192.389.991	120.500.687	97.457.522
ALKA E	84.952.888	82.827.499	89.062.018	97.887.616
YKGYO E	92.249.003	99.094.683	106.148.029	98.260.122
ATEKS E	125.558.690	125.096.489	118.303.073	101.253.018

ACIBD E	120.229.997	120.756.435	132.128.716	101.915.377
ECYAP E	175.058.508	176.623.791	134.056.676	102.262.544
MRSHL E	94.856.265	106.775.061	112.138.728	107.594.219
AKALT E	100.981.085	80.861.886	86.686.598	108.049.332
EGGUB E	97.965.207	99.220.461	107.735.777	108.093.102
SKTAS E	95.951.107	97.887.196	106.322.755	110.026.334
VAKKO E	47.887.311	50.162.337	129.338.726	110.146.024
MUTLU E	86.766.227	96.150.448	110.177.970	111.220.756
NTHOL E	45.576.654	47.516.196	106.399.013	111.692.922
RYSAS E	69.104.044	111.347.500	120.986.519	112.926.627
AVIVA E	29.960.999	42.436.424	69.484.574	114.640.539
EGSER E	69.390.201	70.071.762	77.880.736	120.436.448
SANKO E	82.328.177	93.721.185	94.239.231	121.916.416
BRYAT E	84.429.109	95.603.354	92.430.923	122.338.593
AKMGY E	154.227.936	130.602.802	118.662.682	123.165.897
ISGSY E	89.119.790	104.208.266	106.378.267	123.442.469
ALKIM E	107.200.401	108.563.378	114.654.786	125.487.604
FONFK E	-	77.605.013	187.745.455	127.083.138
ADBGR E	123.776.447	136.665.165	155.167.117	127.326.267
CLEBI E	101.830.978	112.602.992	119.929.764	130.215.019
ADANA E	132.028.210	145.775.917	165.511.298	135.814.685
TATKS E	93.830.608	72.515.965	141.889.295	139.780.844
PRKAB E	109.876.109	115.168.378	129.908.803	140.051.133
OTKAR E	103.593.151	134.933.183	142.506.117	147.897.591
ASLAN E	148.358.879	171.796.442	171.867.163	149.816.604
CEMTS E	88.664.077	111.423.826	135.044.707	149.972.477
KARTN E	174.981.425	189.684.161	153.540.468	152.672.506
IZOCM E	128.516.249	159.090.878	165.782.038	153.047.704
DGGYO E	88.953.980	114.102.335	133.277.263	162.346.364
OLMKS E	136.631.389	151.503.702	171.240.794	166.326.038
IPMAT E	41.770.227	59.425.589	80.862.659	166.655.378
GOLDS E	137.789.695	145.791.123	151.967.682	168.244.697
AGYO E	119.366.653	140.569.951	160.732.848	176.805.503
ISYAT E	155.374.907	166.923.080	201.870.509	179.030.799
KRDMA E	69.385.323	90.331.649	107.556.620	181.611.950
BAGFS E	87.206.254	88.787.559	115.422.178	182.593.243
ALGYO E	152.623.521	156.664.920	158.924.669	182.784.427
ASUZU E	185.181.762	189.351.705	199.632.537	185.462.823
BSOKE E	174.774.603	196.084.620	190.396.766	185.804.828
COMDO E	163.125.960	191.205.525	175.452.676	189.989.995
ALTIN E	146.583.753	144.657.090	155.706.018	196.126.950
ALCAR E	156.654.761	170.790.907	185.897.422	203.661.209
BOLUC E	178.431.457	217.342.394	207.086.887	205.906.039
PARSN E	106.632.093	143.348.139	174.966.449	206.339.183

SARKY E	179.156.027	208.781.144	216.083.808	206.955.800
GLYHO E	132.405.460	158.134.043	304.103.309	207.763.659
MNDRS E	206.609.726	218.925.646	216.285.678	212.777.377
GSRAY E	44.678.061	84.333.922	148.483.264	213.734.455
KENT E	184.076.220	187.769.665	201.908.348	220.131.668
MRDIN E	184.234.956	219.463.135	229.349.351	220.542.961
PRKTE E	99.985.312	129.908.985	143.455.058	223.413.202
BRSAN E	227.179.679	259.664.264	230.558.961	224.560.967
GUSGR E	168.246.591	161.168.550	196.984.012	230.102.331
AYEN E	207.606.107	193.678.785	215.299.149	231.345.374
NETAS E	154.430.369	170.117.684	171.731.896	235.000.488
PETUN E	166.770.944	182.151.479	207.560.514	236.097.859
SASA E	366.959.000	344.114.000	287.700.000	237.002.000
DGZTE E	129.946.416	128.566.888	241.616.401	240.793.202
BUCIM E	164.108.594	194.161.263	236.508.835	242.112.181
ADNAC E	247.552.894	273.329.775	310.333.604	254.652.534
DEVA E	114.502.059	189.450.838	267.883.354	255.422.311
GOLTS E	248.426.897	273.301.497	250.718.132	257.055.203
UNYEC E	199.114.297	255.824.562	266.240.940	258.772.791
GOODY E	213.587.563	241.128.359	256.037.373	263.751.244
BIMAS E	92.720.000	147.181.000	199.993.000	266.103.000
KOZAA E	40.461.406	84.861.682	127.143.686	269.671.079
ISMEN E	138.655.175	152.622.784	246.179.970	272.688.675
ISFIN E	129.779.000	157.365.000	212.582.000	279.006.000
PNSUT E	219.211.199	239.838.822	288.108.223	281.908.662
TTRAK E	275.129.986	293.461.631	277.527.876	285.552.805
BOSSA E	266.053.858	292.728.565	299.818.210	291.182.041
YKSGR E	188.833.170	203.111.663	253.598.079	307.271.380
FFKRL E	169.872.313	209.890.979	260.306.099	308.146.000
GRUND E	273.787.000	123.280.000	100.067.000	308.629.000
GUBRF E	57.083.908	66.890.434	190.571.676	311.627.295
KONYA E	228.795.998	270.909.628	301.689.477	324.921.491
IHLAS E	465.564.738	442.263.851	432.713.789	347.300.148
ANHYT E	312.251.959	321.640.600	344.311.639	349.939.874
DOAS E	468.691.000	478.230.000	540.703.000	350.421.000
BTCIM E	302.117.912	366.239.417	352.819.824	356.390.030
ALNTF E	152.766.000	182.336.000	244.430.000	375.267.000
IZMDC E	191.252.360	247.239.941	300.076.912	392.766.882
BRISA E	419.418.492	412.655.139	437.133.304	417.309.537
GSDHO E	234.640.000	335.900.000	385.981.000	449.548.000
TEKST E	165.809.000	332.117.000	380.462.000	449.827.000
CARFB E	-	286.031.185	299.046.218	460.980.290
VESBE E	229.705.560	455.027.652	497.959.424	477.275.055
AKENR E	488.259.491	428.340.381	388.013.975	477.783.295

TKBNK E	461.500.000	537.533.000	458.096.000	484.158.000
ASELS E	371.776.726	422.119.393	499.967.736	484.496.326
SODA E	365.724.507	433.677.473	422.105.217	487.464.369
TRCAS E	219.491.933	436.659.720	511.096.372	505.662.482
BSHEV E	384.175.730	467.744.639	508.879.016	534.207.773
CMENT E	343.093.000	604.366.000	727.139.000	558.457.000
KRDMD E	225.282.614	293.291.853	349.218.469	589.663.819
ANSGR E	466.404.582	506.457.421	644.088.129	607.990.666
YKFIN E	110.928.943	476.526.102	552.947.217	616.169.411
ANACM E	603.987.481	633.142.080	653.596.314	620.521.891
TAVHL E	195.797.536	574.990.219	556.783.358	629.442.526
ALBRK E	182.490.000	245.905.000	533.780.000	638.102.000
ECZYT E	424.252.465	550.358.594	641.080.142	674.253.174
KORDS E	493.723.752	656.156.574	574.635.226	683.386.667
CARFA E	-	429.046.777	448.569.328	691.470.436
AKSA E	617.868.664	672.480.453	625.244.994	698.351.826
ULKER E	554.487.489	535.976.601	716.140.227	705.944.420
ALARK E	501.040.927	553.860.826	671.740.907	732.982.678
VESTL E	1.055.329.000	1.134.593.000	1.147.957.000	733.716.000
TSKB E	554.136.000	588.518.000	738.352.000	750.057.000
HURGZ E	657.252.467	702.680.186	743.243.326	753.057.582
AKCNS E	738.476.239	789.724.806	841.706.513	753.119.308
NUHCM E	530.803.340	608.029.094	699.983.741	756.486.956
CIMSA E	628.962.097	702.697.758	926.572.046	758.908.440
SELEC E	322.995.414	540.388.850	701.900.203	805.019.874
SNGYO E	-	-	579.815.035	900.400.444
ISGYO E	795.517.708	828.266.036	883.208.272	913.803.506
SKBNK E	349.971.000	436.951.000	864.789.000	975.271.000
DYHOL E	639.515.000	791.568.000	1.372.824.000	1.082.348.000
CCOLA E	666.248.000	848.741.000	910.999.000	1.097.470.000
TOASO E	1.038.277.000	1.017.996.000	1.161.070.000	1.119.461.000
TRKCM E	866.522.218	979.716.416	1.111.374.566	1.243.171.912
TKFEN E	543.133.000	614.291.000	1.201.340.000	1.323.472.000
PETKM E	1.400.069.741	1.458.055.570	1.531.916.460	1.356.592.637
AYGAZ E	926.242.719	1.305.785.532	1.418.022.376	1.400.101.354
ASYAB E	298.534.000	632.519.000	853.856.000	1.403.692.000
YAZIC E	877.861.493	1.051.498.062	1.230.167.557	1.411.224.000
TEBNK E	468.811.000	551.967.000	910.331.000	1.423.619.000
MIGRS E	706.930.000	922.770.000	1.469.068.000	1.623.997.000
FROTO E	1.604.508.394	1.631.412.856	1.715.817.604	1.711.760.462
ECILC E	930.463.248	1.200.798.226	1.658.802.219	1.715.677.252
AKGRT E	1.764.710.420	1.772.084.543	2.638.533.699	1.795.007.864
FORTS E	1.066.467.000	1.114.694.000	1.649.376.000	1.805.009.000
ARCLK E	1.987.056.000	2.103.647.000	2.117.453.000	1.938.064.000

DENIZ E	1.047.632.000	1.236.474.000	1.455.163.000	2.034.140.000
AEFES E	1.384.933.874	1.673.608.000	1.821.553.000	2.154.146.000
SISE E	2.131.082.553	2.356.596.369	2.539.892.949	2.740.407.207
PTOFS E	2.179.353.106	2.342.453.936	2.645.927.371	2.751.595.519
FINBN E	1.397.275.000	2.154.683.000	2.625.878.000	2.839.819.000
THYAO E	1.248.341.593	1.609.718.452	1.904.307.557	2.986.587.096
TUPRS E	3.252.513.682	3.461.599.000	4.111.915.000	3.518.180.000
DOHOL E	2.611.613.322	3.389.539.836	3.757.575.151	3.853.502.000
HALKB E	3.196.499.000	3.779.845.000	4.383.074.000	4.288.827.000
ENKAI E	2.302.533.261	3.015.359.035	3.457.003.000	4.961.082.000
TTKOM E	7.690.359.000	6.410.463.000	6.122.862.000	5.113.607.000
VAKBN E	4.261.408.000	4.487.429.000	5.226.282.000	5.670.999.000
EREGL E	4.801.429.892	5.399.232.539	6.004.441.237	5.936.255.412
YKBNK E	1.677.301.000	3.343.856.000	4.903.749.000	6.853.047.000
TCELL E	4.771.658.000	5.557.347.000	6.670.916.000	8.084.175.000
ISCTR E	9.677.195.550	9.410.055.589	10.603.746.598	9.448.908.166
GARAN E	3.899.624.000	4.670.293.000	6.883.119.000	9.469.074.000
SAHOL E	6.799.159.000	6.854.344.000	8.549.695.000	9.556.971.000
KCHOL E	4.836.959.000	5.087.999.000	7.852.062.000	9.749.491.000
AKBNK E	6.353.219.000	7.065.397.000	10.600.833.000	11.208.372.000

Table 6.1. Companies in IMKB are listed according to their current owners' equities (TL)