Master Thesis Behavioural Economics

Disposition Effect in Aggregate Trading Data

Empirical Test with Unique Korean Data

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Abstract

The disposition effect is unequivocally present in the individual's account level, and I investigate how the phenomenon can be measured at the stock level. I construct two metrics, original and normalised, to measure the realised tendency of gains or losses. I find that the disposition effect can be examined at the stock level in Korea. Using the normalised ratio, I could measure the disposition effect closer to the previous researches who used the account level data in Korea. The sampling data includes 89 common shares listed in the Korean stock market from 2011 until 2017. The results show that the disposition effect is present at the stock level in Korea. The bigger size of the disposition effect is observed with the upper stock trend, smaller capsizes, and drops of the benchmark index and the daily return of the stock itself.

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1. Introduction

Participants in the financial market have realised the puzzle of selling stocks in a profitable situation and holding shares in losing market movements. It is called 'disposition effects' by Shefrin and Stateman (1985). There are numerous papers provided empirical support for the existence of the disposition effect. However, the driving factors are still debated.

Most of the papers examined disposition effect using sample traded contracts of individual investors retrieved from the large size of brokerage firms (Shefrin, & Statman, 1985; Odean, 1998; Ranguelova, 2001; Kim, Choi, and Lee, 2005; Byun (2006); Cerqueira, Rocha, and Duque, J. (2010); Strahilevitz, Odean, and Barber, 2011). There are other papers which investigated the disposition effect during laboratory experiments (Weber and Camerer, 1998; Chui, 2001). However, in this research, I change the way of approach to measuring the disposition effect from individual account level to individual stock level.

The sum of the individual investors trading behaviours generates the total transactions, buy and sell, every day. If the disposition effect exists at the account level, the phenomenon also can be measured at each stock level. To investigate the existence of the disposition effect at the stock level, I use the data in the Korean stock market.

1.1. Literature Review

Previous Research

The disposition effect is introduced by Shefrin and Stateman (1985). Odean (1998) collected 10,000 investing accounts and examined individual investors' strong preferences for selling winners than losers. The disposition effect is observed not only in the U.S. market but also in the other countries such as Israel, Taiwan, and Korea (Shapira and Venezia, 2001; Kim, Choi, and Lee,2005; Shu et al., 2005).

The value function in prospect theory is one possible explanation of the disposition effect. Odean (1998) argued that maximising own utility on the 'S'-shaped value function in prospect theory allowed people to realise gains in short-term and holding losses in long-term. However, Barberis and Xiong (2009) investigated that the prospect theory is not entirely explaining the disposition effect. They emphasised that some cases be predicted by prospect theory, but others were failed to predict.

Additionally, Odean (1998) found pieces of evidence of December effect motivated by tax reimburse from stock market losses. The seasonal tax-motivated selling is examined in Australia by Brown et al. (2006), and it is happening in June, because of the end of the fiscal year in June in Australia. However, the seasonal effects are not examined in the absence of tax benefits. Shu et al. (2005), Kim et al. (2005), Byun (2006) and Firth (2015) analysed that there is no seasonal tax-motivated selling in Asian countries. They used trading data from Korea, Taiwan, and Singapore, and these countries do not have regulations for tax deducted from the stock market losses.

Ranguelova, E. (2001) argued that the cases of disposition effect are founded more often in certain situations such as in large-cap stocks. However, small-cap stocks, categorised as a bottom 40 % of the market capital size in the US stock market, show a reverse disposition effect. Additionally, a possible explanation is the margin call. When account hits the minimum maintenance margin, an investor

should either deposit additional money in the margin account or close a specific portion of the open position of stocks. Ranguelova, E. (2001) used the margin call as an explanation for the disposition effect because the higher volatilities from small-cap stocks may trigger margin calls and it may cause erratic trading behaviour. Shu et al. (2005) did not find evidence that the small-cap stocks have the reverse disposition effect. They found that there are no significant differences in the disposition effect between capsizes.

Dhar and Zhu (2006) used 7965 accounts of individual traders to investigate the differences in the disposition effect bias across the characteristics of investors. They showed that lower income and less sophisticated investors have a higher disposition effect than higher income and higher educated investors. Goo et al. (2010) also found that the evidence of the disposition effect is significantly related with the education level. Using the Taiwanese stock trading date, they found that the investors who have the college degree or advance degree show the smaller size of the disposition effect.

Cerqueira et al. (2010) and Cheng et al. (2013) analysed the disposition effect in market trends, bullish or bearish. They found that the disposition effect is existing both in the bullish market and in a bearish market. However, Cerqueira et al. (2010) argued that the stronger disposition effect is examined during bullish market than the bearish market. On the other hand, Cheng et al. (2013) claimed that they found a stronger disposition effect during the bearish market trend.

Dierick et al. (2018) analysed the disposition effect as the attention of the financial market. They measured attention using how frequently investors request for consulting the portfolio and, log in durations. The result shows that higher attention in investments is associated with lower disposition effect.

Previous Research in Korea

Individual and institutional investors' disposition effect is examined in Korea stock market as well. Kim, Choi, and Lee (2005) investigated that the individual investor's disposition effect is in the overall Korean stock market. They also argued that the disposition effect in Korea is noticeable in the downward market direction than in rising trend. The paper distinguished that the individual investors who hold shares relatively longer show smaller disposition effect.

Investment size, knowledge of investment, and genders matter disposition effect. Byun (2006) found pieces of evidence that larger investment sizes and better knowledge people show less disposition effect. He argued that the stronger disposition effect is observed in the female investors than male investors due to higher loss aversion from female investors. The existence of disposition effect is seen in not only direct investment in the stock market but also investing in equity-related mutual funds.

Ko and Ha (2010) analysed the disposition effect in the equity mutual funds using the money inflow and outflow. They, additionally, investigated the disposition effect on structural change in the mutual funds market. During analysed years from 2001 to 2007, mutual funds boom happened in 2005 due to historically high prices in the stock market. This structural change in the Korean equity market enhanced more disposition effect in mutual fund investing behaviour compare to previous years.

Jeong and Park (2013) examined the disposition effect focus on REITs in the Korean stock market. They used the trading results of 100 demo accounts for five months. They found that the disposition effect is existing even people trade REITs instead of common stocks.

Jeong and Song (2016) investigated that the trading patterns of the institutional investors in Korea and found that the disposition effect is examined in institutional investors as well. They found that the higher disposition effect is examined with the lower risk funds, and higher disposition effect is related with lower returns.

2. Data

2.1 Korean Stock market

The dataset for this study comes from the Korean Stock Exchange (KRX). The Korea stock market is one of the biggest stock markets in the world regarding monthly traded volume and market capitalised size. According to the statistics from the World Federation of Exchanges, the KRX managed the 10th most massive monthly traded volume in the world in January 2017. At the same time, the market capitalisation of Korea stock market is ranked 14th of the largest in the world. (World Federation of Exchanges, 2018). There are four different stock markets in Korea, which named KOSPI, KOSDAQ, FREEBOARD, and KONEX. The abbreviation KOSPI stands for The Korea Composite Stock Price Index, and the KOSDAQ stands for the Korean Securities Dealers Automated Quotations. However, because of the liquidity, market cap size, and transparency only two big markets, KOSPI and KOSDAQ, are being active. The KOSPI is the representative stock market of common shares. On the other hand, the KOSDAQ is the automated quotation market for middle or small sizes companies which could not meet the qualification for listing in the KOSPI market. The purpose of this research is to analyse the disposition effect in the common stock market, and I use the trading data from the KOSPI market.

According to the KRX, the market cap size of the KOSPI market is 1.58 quadrillion KRW, and it is equivalent to 1.46 trillion USD (KRX, 2018). Multi-national corporations such as Samsung Electronics, LG Electronics, Hyundai Motor Company, and KIA Motors are listed on the KOSPI market. The most important index in the KOSPI market is the KOSPI 200 which is the underlying index for futures and options of Korea stock market, and mainly used for benchmark index for index mutual funds.

Advantages of using the KRX stock trading data come from the regulations and the detailed classifications. The KRX distinguish investors 12 different categories. Table 1 demonstrates the specific sections of investors. In this research, I mainly use the investor code of 8000, individual investors, for investigating disposition effect.

Investor Code	Investors
1000	Securities Company and Futures Company
2000	Insurance Company
3000	Asset management and Investment Companies
3100	Private Equity Funds
4000	Commercial banks
5000	Other Kinds of Banks
6000	Pension funds and Mutual Aid Associations
7000	The central government, local governments
7100	Other corporates
8000	Individual Investors
9000	Foreign Investors (Investment licenses hold)
9001	Other foreign investors

Table 1. Categories of investors by KRX. Source. KRX

There are two limitations of dataset announced by KRX. First, in most case, the number of stocks sold or bought by each investing parts should be the same. However, unmatched cases may exist under specific circumstances, such as the revised order in specific periods of time. Second, there were no different categories of foreign investors until December of 2003. These limitations are not so relevant to this research. Most of the unmatched cases are existing until 1997 before the KRX introduced electronic settlements. (KRX, 2012) However, the problematic data is not including in this paper.

The tax system in the Korean stock market is simple. There is no capital gains tax and no regulation for deducting tax from the stock market losses. Only 0.3 % will be paid from the total amount of money sold no matter investors gained or lost. There are some capital gains tax for trading specified ETFs and collecting dividends, but it is not the case in my research.

2.2 Data collection

The data is retrieved from one of the brokerage firm in Korea, named Daishin Securities using the API. It is possible to access most of the stock market data, such as total traded volumes, closing price, the number of outstanding shares. Moreover, the sum of the bought, the sum of the sold, and the sum of the net traded shares for each category of investors allow us to analyse the disposition effect. To use the data for analysis, several pre-processing steps are necessary.

First, I constructed the universe of securities. The total listed securities in the KOSPI market, the primary stock market in Korea, is 1497 including the preferred stocks, ETFs and SPACs. As the goal of this paper is to analyse the disposition effect in common shares, I omit all the preferred stocks, ETFs, and SPACs on the list. In the end, 737 ordinary companies are chosen as the universe of securities.

Second, I randomly choose 100 stocks from the universe of securities for computational reasons. The cap sizes are not considering in this sub-sampling process. It means that I do not randomly choose stocks within groups of large-cap, mid-cap or small-cap stocks. The reason is that stocks in each category are changing every year between groups based on the market cap sizes.

Third, the dummy variables for market capitalisation are generated using the effective dates of market cap categories. There are three different types of market cap sizes in Korea, large, mid and small. From 1 to 100 top market-cap securities are large-cap stocks. From 101 to 300 securities are mid-cap stocks, and rest of them become small-cap stocks. Once a year, the KRX announce the list of the companies and the effective day. At the effective day, the KRX change the categories and the institutional investors allocating the assets. I download all files of the listed stocks from the announcement and generate dummy variable based on the effective date. If there are any stocks listed between the announcement date, the status of the company is ‘not categorised’. In this case, I modify the not categorised to the first announced market cap category. For example, the company become mid-cap at the first announcement day, the previous periods as ‘not categorised’ are modified to mid-cap.

Lastly, generate the subset of the sample to match the period from the survey results. The survey result is used for generating inferred holdings in the chapter 4.1.4. The range of the subset is the periods from the first trading day in 2011 until the last trading day in 2017. 11 stocks were dropped because of the unusual market events such as the reduction of capital or not having enough trading days. The days of none of the trading caused by the individual investors were deleted. There are 26 days of none of the stocks sold, and I dropped it from the entire sample.

To sum up, the data is the panel data, and it has 89 companies and 7 years of daily trading results. The full length of time variables is 1718 trading days for 7 years. It is unbalanced data because of the different listed dates on the stock market. In total 62 companies have 7 years trading data, but 27 companies have shorter trading days.

Table 2 shows that the number of stocks in each market cap sizes every year. The period of the year is from the March to next year March because the effective day of the market cap size is in March. For example, the 16 large cap stocks in 2012 mean that 16 stocks are categorised as the large-cap stocks from 2012 March until 2013 March according to the announcement from the KRX. Table 3 shows that the number of observations in each market cap sizes every year. The period of the year is from the first trading day to the last trading day of each year.

	2011	2012	2013	2014	2015	2016	2017	Average
Large Cap	11	16	16	16	15	15	15	14.85714
Mid Cap	30	25	25	23	25	27	25	25.71429
Small Cap	38	41	43	46	46	44	49	43.85714
Total	79	82	84	85	86	86	89	84.42857

Table 2. The number of stocks in each cap sizes

	2011	2012	2013	2014	2015	2016	2017	Total
Large Cap	2981	3772	3936	3881	3799	3663	3614	25646
Mid Cap	7046	6490	6187	5708	6081	6527	6153	44192
Small Cap	9430	9932	10500	11120	11347	10851	11643	74823
Total	19457	20194	20623	20709	21227	21041	21410	144661

Table 3. The number of observations in each cap sizes

3. Research Question

The main research question in this paper is that the disposition effect can be examined using the aggregate stock trade contracts in Korea. Without using the trading results from every single individual's account level, I want to analyse how individual investors behave in the market as one representative investor.

My research question is:

Is the disposition effect present at the stock level in Korean Market?

I also study if DE is affected by capsizes, seasonality, the trends of the stocks and the return changes of the benchmark index.

Odean (1998), Shu et al. (2005), Kim et al. (2005), Byun (2006) examines the differences between the value of the Proportion of Gains Realised (PGR) and the value of the Proportion of Losses Realised (PLR) at the individual level. In order to examine the disposition effect at stock level, I generate the PGR and PLR of stocks, and compare it. If the PGR is larger than PLR, it is the disposition effect.

Hypothesis 1. Is the disposition effect present at the stock level in Korean Market?

The null hypothesis is $\mathrm{PGR} \leq \mathrm{PLR}$ and the alternative hypothesis is $\mathrm{PGR} > \mathrm{PLR}$.

Ranguelova (2001) argues that the disposition effect is concentrated in large-cap stock in the US stock market. She finds that the traders in small-cap stocks show the reverse disposition effect. On the other hands, Shu et al. (2005) examines that there are no differences in the disposition effect on the market cap sizes using the Taiwan stock market. There is no previous research of analysed the disposition effect using the market-cap in Korea. I analysis the disposition effect on three different market cap sizes, large-cap, mid-cap, and small-cap.

Hypothesis 2. The disposition effect is present in all market cap sizes.

The null hypothesis is $\mathrm{PGR} \leq \mathrm{PLR}$ every market cap size. The alternative hypothesis is $\mathrm{PGR} > \mathrm{PLR}$ in every market cap size.

Odean (1998) examined the phenomenon that investors more sold their winners than losers in the trading account during entire year. However, realised the losses are much larger in December than realised ratio throughout the rest of the year. The tax-motivated selling is the possible explanations of the December effect in US stock market. Brown et al. (2006) analyses that the similar effect is existing in Australia stock market. The phenomenon is examined in June because of the end of the fiscal year in June in Australia. Without the tax benefits, the seasonal effect can be eliminated. Firth (2015) claims that the disposition effect is presenting, and the seasonality is not examined when there are no more tax benefits.

The tax system can be an important factor of the seasonal effect. There are researches about tax-motivated selling not existing in Asian countries. Shu et al. (2005) analyses that Taiwan people worry more about capital gain taxes but they do not care much about the yearend tax-motivated selling.

Researchers examine that the PGR is higher than PLR entire year and the ratios are narrowed down April and November. However, the small amount of the disposition effects in April and November are not supporting the possible explanation of the seasonal effect that caused by the cultural events, Chinese New Year or tax-paying season.

Byun (2006) argues that the December effect is not existing in Korea. The result shows that PGR is greater than PLR in December, and there are similar trading patterns in August, September and October as well. He concludes that there is no December effect in Korea, and no economic reasons for selling behaviours in August, September and October.

There are two hypotheses for examining the seasonality of the disposition effect in Korea. The hypothesis 3 expands the previous research from Byun (2006) and it is simply comparing the sizes of the disposition effect in December and other months. The motivations for the hypothesis 4 is that there is any seasonal differences of the disposition effect between summer and winter seasons. The summer months are April, May, June, July, August and September. The winter seasons have October, November, December, January, February, and March.

Hypothesis 3. The December effect is not present in Korea.

The null hypothesis is $DE_{Not\ December} = DE_{December}$. The alternative hypothesis is $DE_{Not\ December} \neq DE_{December}$.

Hypothesis 4. The sizes of the disposition effect is not the same between seasons.

The null hypothesis is $DE_{Summer} = DE_{Winter}$. The alternative $DE_{Summer} \neq DE_{Winter}$

Kim et al. (2005) and Byun (2006) analysed the disposition effect on the market trends, upper trend and lower trend using the benchmark index (KOSPI). Two researchers found that the existence of the disposition effect, no matter what market trends of the benchmark index. They emphasise that the stronger disposition effect be examined when the benchmark index has a downtrend. More specifically, the higher PGR is examined in lower trends, and it causes the higher disposition effect when the benchmark index drops. However, they have different opinions about the PLR values. Kim et al. (2005) argue that the PLR upper trend is statistically higher than PLR downtrend. On the other hand, Byun (2006) claims that there are no statistical differences in PLR values between upper and lower trends.

I extend the way of analysing the market trends using three different approaches because the way of constructing the trends of Kim et al. (2005) and Byun (2006) has two flaws. Here are the reasons.

First, the KOSPI is a capitalisation-weighted index, and it can be distorted by the few large-cap stocks movements in Korea. Only 9 stocks are representing 32 % of capitalisations of KOSPI index. Moreover, 100 large-cap stocks have 90 % of market capitalisation. The price changes of middle-cap or small-cap stockholders may not follow the movements of the KOSPI index. In other words, the trend of KOSPI is not representing the price changes of all stocks in the Korean market. Second, the way of choosing the trend is not appropriate. The authors choose the trend using the peak and bottoms ex-post. The problem is that no one knows the day is the peak or the bottom of the trends at day t.

Because of the drawbacks of the trend variables from previous researchers, I generate alternative

variables to analyse the market trend effect. The first variable is the daily return changes of the benchmark index instead of using the peak and bottom of the benchmark index ex-post. It makes more sense for investors comparing their daily performances against the benchmark index than presuming the trend of the market. The second variable is the trend of the stock itself. Each trend variable is unique for every single company, and the last variable is the daily return changes of the stock itself.

The motivation for hypothesis 5 is that investors may feel less happy with their gains when the benchmark index goes up on the same day. And some investors who are facing losses may expect their holding stocks go up soon following benchmark index. These two cases may reduce the disposition effect. To analyse the disposition effect, I categories as dummy variable using the return changes of KOSPI. When the KOSPI goes up compare to yesterday, it is UP. Otherwise, it is a DOWN.

Hypothesis 5. The disposition effect is smaller when the benchmark index rises at day t.

The null hypothesis is $DE_{KOSPI\ UP} \geq DE_{KOSPI\ DOWN}$, and the alternative hypothesis is $DE_{KOSPI\ UP} < DE_{KOSPI\ DOWN}$.

In order to analyse the effect of the trend, the trend variable of each ordinary shares is needed. The trend variable for each individual stock is generated by the moving averaged prices. When the 20 days of moving averaged price are higher than the price of 60 days of moving average, the stock is in the upper trends. Otherwise, it is in the lower trends. The trend using the 20 and 60 moving average is easy to understand, and it is commonly using. Investors may realise more stocks when they see the stocks are on the upper trend.

Hypothesis 6. The disposition effect is larger when the stocks in upper trends. The null hypothesis is $DE_{Trend\ UP} \leq DE_{Trend\ DN}$, and the alternative hypothesis is $DE_{Trend\ UP} > DE_{Trend\ DN}$.

The next hypothesis is measuring the disposition effect based on the daily return changes. People may be afraid of the situation that their profits are becoming losses. For example, if a person had 5 % of gains yesterday. Today the stock returns drop 3 %, and it makes the person only has 2 % of profits now. He or she may feel fears the situation that tomorrow's stock price would drop by to 3 % again, and the profits changed to losses. To avoid the losses, people may sell their gains when the stock return drops. The variable is a dummy variable with the daily return changes of the stock itself. When the stock goes up, it is the Daily Return UP. Otherwise, it is Daily Return DOWN.

Hypothesis 7. The disposition effect is smaller when the daily return goes up. The null hypothesis is $DE_{Return\ UP} \geq DE_{Return\ DOWN}$ and the alternative hypothesis is $DE_{Return\ UP} < DE_{Return\ DOWN}$.

4. Methodology

4.1. Development of Metrics

To investigate the disposition effect in the Korean stock market, I follow a similar methodological approach as in Odean (1998), Kim et al. (2005) and Byun (2006). Calculation of the Proportion of Gaining Realised (PGR) and the Proportion of Losses Realised (PLR) follows the previous research, but I extended it by cancelling out the external shocks.

4.1.1. Previous Methodology

Odean (1998) developed the proportion of Gaining Realised (PGR) and the proportion of Losses Realised (PLR) as following.

$$Proportion\ of\ \ GainsRealised(PGR)\ = \frac{Realised\ Gains}{Realised\ Gains + Paper\ Gains}$$

$$Proportion\ of\ Losses\ Realised\ (PLR)\ = \frac{Realised\ Losses}{Realised\ Losses + Paper\ Losses}$$

$$SE\ = \sqrt{\frac{PGR(1-PGR)}{n_{rg}+n_{pg}} + \frac{PLR(1-PLR)}{n_{rl}+n_{pl}}}$$

$$DE(Disposition\ Effect)\ =\ PGR\ -\ PLR$$

Previous researchers used the contract data from the brokerage firms. The method is analysing the propensity of realised (gaining or losing) over how many stocks holding in the account. The amount of the disposition effect is the gap between PGR and PLR.

4.1.2. Normalisation Methods

The PGR_t(Proportion of Gains Realised) and PLR_t (Proportion of Losses Realised) are going to be the main measurement for the disposition effect in this paper as well. However, due to the nature of the aggregated data, there are two differences in my methods. The first one is normalising the selling propensity to cancel out the effects of the external shock. The other one is inferring the aggregate holdings of investors. I am going to cancel out the external shock using two normalising factors and inferring the holdings based on actual holdings from the depository firm.

Since I decided to use the aggregate trading data from the stock exchange, the external shocks such as news and events are having an impact on all stocks simultaneously. It can interfere with the trader's behaviours. If the external shock comes, for example, bad rumour, the market participants enter the stock market and sell off the stocks. It is not selling caused by the experiencing profits or losses but just selling off. I want to avoid this external shock in the measurements.

The first normalising factor (NF_{V_t}) means the normalising methods with trading volume, V. The NF_{V_t} is constructed by the ratio of the averaged total traded volume over the total traded volume at day t. Total traded volume is the total amount of stock traded at day t. The numerator is the average of 20 trading days (one month) of total traded volume but not including the values at day t. The denominator is the total traded volume at day t. The value at the day t is excluded for calculating average value because it helps to measure the exact averaged trading volume of last month. If the external shock happens at day t and including the value at day t for measuring the averaged value, the averaged values are affected by the external shock as well. It can cause the normalising factor less effective.

If the traded volume at day t is larger than one month averaged traded volume (20 trading days) the normalising factor decreases the number of stocks realised at day t. If the traded volume is smaller than one month averaged traded volume, the factor increases the number of stocks sold.

$$NF_{V_t} = \frac{Vol_{Avr_t}}{Vol_t}$$

$$Vol_{Avr_t} = \frac{\sum_{i=t-1}^{t-21} Vol_i}{20}$$

The second normalising factor (NF_{IR_t}) is the normalising factor with individual's participation ratio (IR_t) in the market. The way of calculation for IR_t is that if the individuals trade 40,000 shares (20,000 bought 20,000 sold) and the total traded volume is 100,000 shares, the individual's participation ratio IR_t becomes 0.2 = (20,000+20,000)/200,000. Because the way of counting total traded volume is only counting the number of stocks that handed over. When one person sells 1 stock to another person (buy), the exchange counts total traded volume as 1, not 2. In this case, the total bought and sold numbers are 2, 1 sold and 1 bought, but the total traded volume counts only 1 stock. Thus, all the sum of transacted stocks (bought + sold) by all market participants become the double of the total traded volume at day t. For calculating the averaged value of the individual's participation ratio IR_{AVR_t}, the periods are not including the day t. The reason is the same as constructing the Vol_{Avr_t}. If there is any external shock at day t, the averaged value including the value at day t will not represent the averaged values of last month.

The NF_{IR_t} is constructed by the 20 days of individual traders' participation ratio over the entire market.

$$NF_{IR_t} = \frac{IR_{AVR_t}}{IR_t}$$

$$IR_{AVR_t} = \frac{\sum_{i=t-1}^{t-21} IR_i}{20}$$

$$IR_t = \frac{Ind_t}{Total_t}$$

If the individual´s participation ratio at day t is larger than the one-month averaged participation ratio, the normalising factor $NF_{IR_t}$is lower than 1 and it decreased the number of stocks sold at day t.

The normalised stocks sold NS_t is the number of stocks sold at day t multiplied by these two

normalising factors:

$$NS_t = Number\ of\ Stocks\ Sold_t * NF_{V_t} * NF_{IR_t}$$

4.1.3. The Disposition Effect

The disposition effect is measured by the differences between the two metrics, PGR and PLR, and the metrics are the realised ratio of stocks over holdings. The realised ratio is the proportion of selling over its holdings into the account. In this paper, the main difference is the way of the thinking about the individuals. Previous papers conduct the disposition effect using each investor level by the transaction data from the brokerage firms. I change the point of view of individuals. My point is that if the disposition effect is unequivocally present, how it can be measured in the sum of the behaviour of every single individual. I measure the realising behaviour of the sum of all individuals, and it measures at the stock level.

From now on the terminology 'individual' is the investor who is representing whole individual investors in the stock market. Thus, the holdings are the total holdings of individuals in the entire stock market. The number of stocks realised is the total number of realised stocks in the market by every single individual investor.

To investigate the disposition effect, constructing the propensity of selling is needed to be done first. There are two different types of realised propensities in this paper. The first one is using the original metrics as *PGR* and *PLR*. The additional metrics are normalised ratio named *NPGR* and *NPLR.*

Original realised ratio is following previous metrics of Odean(1998).

$$PGR_t = \frac{RG_t}{RG_t + PG_t} = \frac{S_t * \Delta P_t}{S_t * \Delta P_t + (H_{t-1} - S_t) * \Delta P_t} \quad while\ \Delta P_t\ > 0$$

$$PLR_t = \frac{RL_t}{RL_t + PL_t} = \frac{S_t * \Delta P_t}{S_t * \Delta P_t + (H_{t-1} - S_t) * \Delta P_t} \quad while\ \Delta P_t\ <= 0$$

Using the normalised number of stocks sold, the normalised Propensity of Gaining Realised (PGR_t) and the normalised Propensity of Losing Realised (PGR_t) are generated.

$$PGR_t = \frac{RG_t}{RG_t + PG_t} = \frac{NS_t * \Delta P_t}{NS_t * \Delta P_t + (H_{t-1} - NS_t) * \Delta P_t} \quad while\ \Delta P_t\ > 0 \qquad (1)$$

$$PLR_t = \frac{RL_t}{RL_t + PL_t} = \frac{NS_t * \Delta P_t}{NS_t * \Delta P_t + (H_{t-1} - NS_t) * \Delta P_t} \quad while\ \Delta P_t\ <= 0 \qquad (2)$$

Where

RG_t,RL_t= Realised Gains or Losses

PG_t,PL_t= Paper Gains or Losses

NRG_t,NRL_t= Normalised Realised Gains or Losses

NPG_t, NPL_t= Paper Gains or Losses

S_t = Total number of stocks realised on day t by all individuals

NS_t = Normalised number of stocks realised on day t by all Individuals

H_t = Inferred Holdings at the end of day t of all individual investors

$\Delta P_t = CP_t - RP_t =$ Price differences between closed price on day t and reference price

CP_t = Closed price at day t

RP_t = Reference price at day t

The *DE* is the differences between *PGR* and *PLR.*

$$DE = PGR - PLR$$

The determinant factor between *PGR* and *PLR* is the price differences ΔP_t ($CP_t - RP_t$). It is same as previous methods for disposition effect.

The Welch's t-test is used for calculating the t-statistics. The realised ratios are mainly categorised for two, *PGR* and *PLR*, and the variances are different.

4.1.4. Aggregated Holdings

The aggregated individual investors' holdings are unknown. To calculate the PGR and PLR from the equation (1) and (2), it is necessary to generate the holdings. I use the linear regression to predict the holdings based on 28 stocks for which holdings are publicly available. These 28 companies deputed the entry of a change of a holder to the firm named Korea Securities Depository (KSD). That is why actual individual investors' holdings are available for every fiscal year. The regression in 2010 is done by 27 stocks, and 28 stocks used for other years.

Inferred Holdings of the each year (IH_y) is

$$IH_y = \beta_0 + \beta_1 * Outs_y + \beta_2 * Ind_y + u$$

Where $Outs_y$ is the mean of the number of outstanding stocks in the stock market in year y, and Ind_y is the mean value of individual's daily trading amount which means the sum of the total number of bought and sold.

The inferred holdings are the individual's holdings at the last trading day of the year, just same as the closed point of the fiscal year. When the stock market opens next year, after the new year break, the sum of the daily trading results cumulates every day to generate the everyday holdings.

$$DIH_t = IH_{y-1} + \sum_{t=1}^{n} NT_t$$

$$NT_t = B_t - S_t$$

The Daily Inferred Holdings (DIH_t) are generated by the cumulative summation of daily net trading stocks ($NT_t = B_t - S_t$). Here is the example. The inferred holdings in 2010 are generated using the coefficients of the regression in 2010. In 2011, the inferred holdings at the end of 2010 (IH_{2010}) is

used because the value of IH_{2010}indicates the amount of the holdings at the last trading day in 2010. Let's say the value of IH_{2010} is 1,000,000. When the market opens on the first day of the year 2011, the net trading stocks are generated. On the first day of the market, 1100 stocks are bought, and 1000 stocks are sold, and the net traded values become + 100. The day of the first trading day in 2011, the inferred holding of individual investors becomes 1,000,100. The same process is keeping on going for rest of the year. The value of the $DIH_t$is the value of the $H_t$to calculate the equations (1) and (2).

	2010	2011	2012	2013	2014	2015	2016	Average
Constant	3704012	4699427	5598969	6014007	5399357	4894633	834526.3	4449276
Outstanding	0.08963	0.08578	0.18123	0.11406	0.10458	0.09666	0.05696	0.10413
Individual	20.2609	24.1419	0.87921	13.7141	14.9656	13.3497	66.7542	22.0094
R^2	0.8320	0.7314	0.6868	0.6121	0.7014	0.7281	0.8171	0.7298
Observations	27	28	28	28	28	28	28	27.85

Table 4. The sizes of the coefficients and the $R^2$of the regression results

The highest $R^2$is 0.8320 and the lowest $R^2$is 0.6121. The average of $R^2$is 0.7298. The coefficients of constant, the mean of outstanding stocks, and the mean of traded stocks by individuals are explaining 73 % of individual traders' holdings.

4.1.5. The Reference Price

Because of the using aggregate trading data from KRX, I do not have the exact actual reference price of each individual investor. To calculate the ΔP_t from the equation (1) and (2), it is necessary to construct the reference price (RP_t). To construct the reference price, I use one of the survey results from the Korea Finance Investment Association (KFIA) which was surveyed between 2007 and 2012. The results in fig 1 indicates how often individual investors trade over the year. The portion in the bright blue colour indicates people who trade more than once in a week. The blue colour indicates the portion of people who trade 2 or 3 times per month. The numbers in the dark blue colour show the traders who trade once a month. The numbers in white colour indicate people not trade much. The survey indicates that the high percentage of people trade more than once a month.

The results from the survey are available from 2007 to 2012, but I use only the survey results from 2010, 2011 and 2012. The results from 2007 to 2009 are excluded because the periods seem to be affected by the financial market issues such as the financial crisis in the US and the credit crisis in Europe.

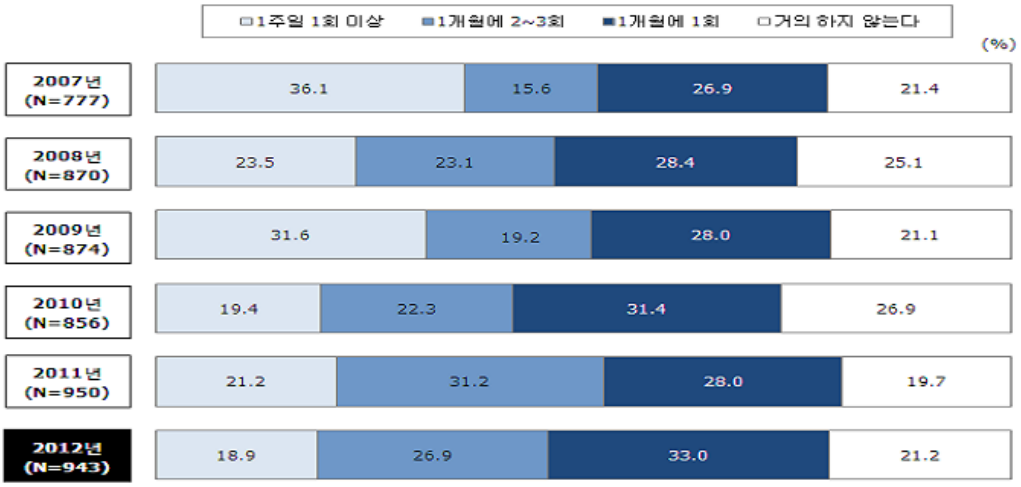


Fig 1. Survey results from the Korea Finance Investment Association (2013)

The ratio mentioning below are used for constructing the reference price. The reason is that the P/L on the screen is cumulated through all trading results. For example, the returns of stocks that I purchased last month and the returns of stocks that I bought last week are cumulated and showing the averaged return on my screen. I assume that the weighted average price is representing the individual's trading results.

19.8%: mean of values from D-1 to D-5 (someone who trade once a week)

26.8%: mean of values from D-15 to D-6 (someone who trade two or three times per month)

30.8%: mean of values from D-20 to D-16 (someone who trade once a month)

22.6%: mean of values from D-120 to D-21 (someone who trade not often)

100% of weighted traded activities during 6 months as a representative person of individual investors.

5. Results

The results consist of two parts. The first one measures the disposition effect using the t-test within each condition necessary for the hypotheses. There are six different conditions, aggregate level, market cap sizes, seasonal differences, daily return changes of the benchmark index, market trends of the stocks, and the daily return changes of the stock.

The second part analyses the disposition effect using the panel regression.

5.1 Testing for DE

The values of the results are multiplied by 100 to make the percentage changes. The value of the number is per cent. For example, the number 1.2 means that investors tend to realise 1.2 % of their holdings.

Almost all of the results from both the original ratios and the normalised ratios present similar pattern of DE. In the results section, I use the normalised ratio for measuring the disposition effect.

5.1.1 Aggregate level

Hypothesis 1. Is the disposition effect present at the stock level in Korean Market?

The null hypothesis is $\mathrm{PGR} \leq \mathrm{PLR}$ and the alternative hypothesis is $\mathrm{PGR} > \mathrm{PLR}$.

	Entire sample
Total Realised Ratio	0.9360613 (0.0076)
PGR	1.139944 (0.0131)
PLR	0.7489499 (0.0084)
Diff (=DE)	0.3909938 (0.0156)
T-Stats	25.1321
P-Value	0.0000

Table 5. Statistical Values of the normalised results

The results on the table 5 indicate that the existence of the disposition effect in the Korean stock market. The ratio of realised gains is significantly higher than the ratio of realised losses at 1 % level for 7 years, and it shows that there is a strong evidence of existing the disposition effect in the Korean stock market. The results table for original ratios are almost same and it is in the appendix.

5.1.2 DE and the market cap size

Hypothesis 2. The disposition effect is examined in all market cap sizes. The null hypothesis is $\mathrm{PGR} \leq \mathrm{PLR}$ every market cap size. The alternative hypothesis is $\mathrm{PGR} > \mathrm{PLR}$ in every market cap size.

The results on Table 6 and the figure 2 show that individual traders sell more in gains than losses all market-cap sizes, and it indicates the existence of the disposition effect for all capsizes. The results are not in line with the previous research done by Ranguelova (2001). Because she mainly examined

the DE in large-cap stocks but I find DE everywhere. My results are in line with the previous research from Shu et al. (2005) because they found the DE every market cap size.

However, there are two differences between the results from Shu et al. (2005). The gap between PGR and PLR is getting wider when the market cap size becomes smaller. Also, the variances of realised ratios are increasing when the market cap sizes become smaller. The large-cap stocks have lower deviations between PGR and PLR, and it is becoming wider when the market cap sizes are smaller. The same pattern is examining both the original ratio and normalised ratio.

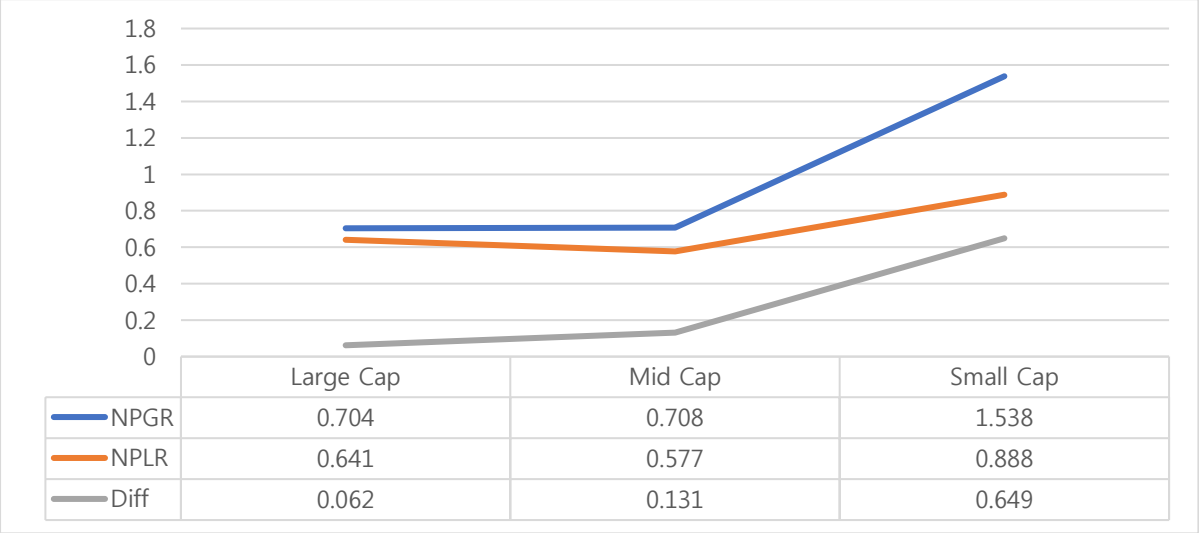


Figure 2. The realised ratios and the size of the disposition effect on the market cap sizes.

	Full Sample	Large Cap	Mid Cap	Small Cap
PGR	1.139 (0.013)	0.704 (0.0062)	0.708 (0.0088)	1.538 (0.0242)
PLR	0.748 (0.0084)	0.641 (0.0057)	0.577 (0.0065)	0.888 (0.0158)
Diff(=DE)	0.390 (0.0153)	0.062 (0.0085)	0.131 (0.0110)	0.649 (0.0289)
T-Stats	25.1321	7.3991	11.9416	22.4212
P-Value	0.000	0.000	0.000	0.000
Sample Size	144,661	25,646	44,192	74,823

Table 6. Normalised realised ratios over market cap sizes

The phenomenon of the bigger disposition effect with smaller cap sizes can be explained by the individual traders' participation ratio. Table 7 shows the descriptive statistics of the individual investors' participation ratios by three different market cap sizes. The smaller market cap-sizes, the bigger individual's participation ratios are examined. The Figure 5 also depicts the relation between market-cap and the participation ratios. The results on Table 8 show that the bigger participation ratios have the larger amount of the disposition effect under both original and normalised realised ratios.

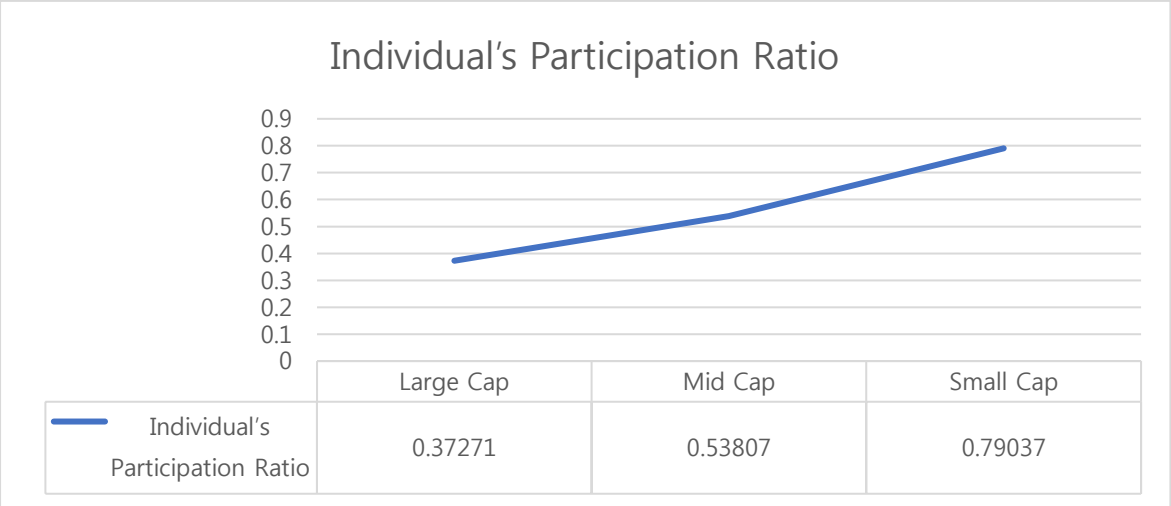


Figure 3. Individual traders' participation ratio over entire market

	Individual's Participation Ratio	Standard Deviation	Sample size
Large Cap	0.37271	0.1983	25646
Mid Cap	0.53807	0.22039	44192
Small Cap	0.79037	0.24381	74823
Total	0.63925	0.28306	144661

Table 7. The descriptive statistics of the individual investors' participation ratio

	DE_{Org}	DE_{Nor}
Individual's Participation Ratio < 0.4	0.07482	0.06838
0.4 < Individual's Participation Ratio < 0.7	0.18060	0.12933
Individual's Participation Ratio > 0.7	1.55242	0.74949

Table 8. The sizes of the disposition effect based on the individual traders' participation ratios

5.1.3 The Seasonal Effects on the disposition effect

Hypothesis 3. The December effect is not present in Korea.

The null hypothesis is $DE_{Not\ December} = DE_{December}$ in December. The alternative hypothesis is $DE_{Not\ December} \neq DE_{December}$ in December.

I find that there is no December effect in Korea. It is similar results with previous researches from Asian countries by Shu et al. (2005) and Byun (2006). The PGR is still higher than PLR in December, and it is statistically significant. The results on table 9 show that whether the month is December or not, the values of PGR is always higher than the values of PLR.

Moreover, I compare the sizes of DE in December and rest of months. The DE is existing entire year.

The higher DE is examined during the periods of except December but the differences between December and except December is not statistically different.

	Full Sample	Except December	December
PGR	1.139 (0.013)	1.148 (0.0137)	1.026 (0.0392)
PLR	0.748 (0.0084)	0.748 (0.0089)	0.757 (0.0254)
Diff(=DE)	0.390 (0.0153)	0.401 (0.0164)	0.269 (0.0449)
P-Value	0.000	0.000	0.000
Sample Size	144,661	132,786	11,875

Table 9. Normalised realised ratios in months

	Mean	SE	T-Test	P-Value
DE Except December	0.4006938	0.163965		
DE December	0.2674008	0.046799		
Diff	0.133293	0.1705131	0.7817	0.4344

Table 10. the disposition effect using normalised ratios

Hypothesis 4. The sizes of the disposition effect is not the same between seasons.

The null hypothesis is $DE_{Summer} = DE_{Winter}$. The alternative $DE_{Summer} \neq DE_{Winter}$

According to the results on the Table 11 and Table 12, the DE exists in Korea entire year. However, the sizes of DE are not the same between summer seasons and winter seasons at the 10 % significant level. It means that there is a seasonal effect of DE in Korean stock market.

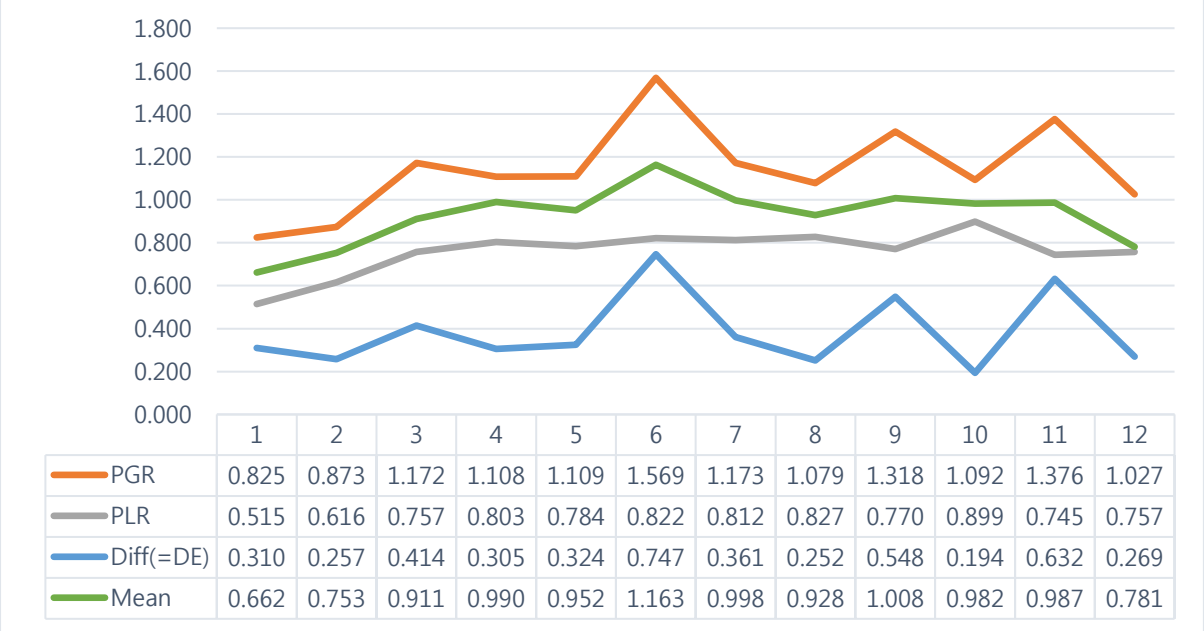
	Full Sample	Summer Seasons	Winter Seasons
PGR	1.139 (0.013)	1.216 (0.0194)	1.057 (0.0172)
PLR	0.748 (0.0084)	0.804 (0.0131)	0.694 (0.0106)
Diff(=DE)	0.390 (0.0153)	0.412 (0.0234)	0.362 (0.0203)
P-Value	0.000	0.000	0.000
Sample Size	144,661	73,080	71,581

Table 11. Normalised realised ratios in months

	Mean	SE	T-Test	P-Value
DE Summer	0.4124	0.02346		
DE Winter	0.3629	0.01693		
Diff	0.0494	0.02893	1.7101	0.0873

Table 12. the disposition effect using normalised ratios

The higher DE is examined in June, September, and November. Fig 3 depicts the higher disposition effect is mainly caused by the higher PGR while the values of PLR are not fluctuating. Following previous researches from Byun (2006) and Shu et al. (2005), I do not have any supporting ideas of the higher disposition effect in specific months.



	1	2	3	4	5	6	7	8	9	10	11	12
PGR	0.825	0.873	1.172	1.108	1.109	1.569	1.173	1.079	1.318	1.092	1.376	1.027
PLR	0.515	0.616	0.757	0.803	0.784	0.822	0.812	0.827	0.770	0.899	0.745	0.757
Diff(=DE)	0.310	0.257	0.414	0.305	0.324	0.747	0.361	0.252	0.548	0.194	0.632	0.269
Mean	0.662	0.753	0.911	0.990	0.952	1.163	0.998	0.928	1.008	0.982	0.987	0.781

Fig 4. The normalised realised ratios in each month

5.1.4 DE and Market Trends

Hypothesis 5. The disposition effect is smaller when the benchmark index rises at day t.

The null hypothesis is $DE_{KOSPI\ UP} \geq DE_{KOSPI\ DOWN}$, and the alternative hypothesis is $DE_{KOSPI\ UP} < DE_{KOSPI\ DOWN}$.

The results from the hypothesis 5 are close to the previous researches in Korea. First, the larger amount of the disposition effect is existing when the benchmark index drops, but it is not statistically higher at 10 % significant level, the p-values is 0.106. Second, the higher PGR is examined when the benchmark index drops. The results on Table 14 show that $PGR_{KOSPI\ DN}$ is statistically higher than $PGR_{KOSPI\ UP}$. One different result from the previous researches in Korea is the values of PLR. The values of $PLR_{KOSPI\ UP}$ is smaller than $PLR_{KOSPI\ DN}$ and it is not following the previous research in Korea.

The results present the behaviour that people realise their gains more when the benchmark index drops, and they are keeping their losses when the benchmark index goes up.

	KOSPI UP	KOSPI DOWN
PGR	1.111 (0.017)	1.171 (0.020)
PLR	0.738 (0.012)	0.759 (0.012)
Diff(=DE)	0.373 (0.021)	0.412 (0.023)
T-Stats	17.978	17.618
P-Value	0.000	0.000
Sample Size	73,750	70,911

Table 13. Realised ratios on changes of the benchmark index

	Mean	SE	T-Test	P-Value
$DE_{KOSPI\ UP} = PGR_{KOSPI\ UP} - PLR_{KOSPI\ UP}$	0.3732	0.0206		
$DE_{KOSPI\ DOWN} = PGR_{KOSPI\ DOWN} - PLR_{KOSPI\ DOWN}$	0.4122	0.0226		
$Diff = DE_{KOSPI\ UP} - DE_{KOSPI\ DOWN}$	-0.0389	0.0306	-1.2716	0.106
$Diff = PGR_{KOSPI\ UP} - PGR_{KOSPI\ DOWN}$	-0.0599	0.0261	-2.2787	0.011
$Diff = PLR_{KOSPI\ UP} - PLR_{KOSPI\ DOWN}$	-0.0210	0.0169	-1.3019	0.096

Table 14. Comparing the size of the disposition effect and the realised ratios

Hypothesis 6. The disposition effect is larger when the stocks in upper trends.

The null hypothesis is $DE_{Trend\ UP} \leq DE_{Trend\ DOWN}$, and the alternative hypothesis is $DE_{Trend\ UP} > DE_{Trend\ DOWN}$.

The size of the DE is significantly higher when the stock has upper trend. Which means that when the 20 days of averaged stock price is higher than 60 days of averaged stock price, investors tend to sell more their gains than riding the upward trends. The results on table 16 show that the DE in the upper trend is significantly higher than the DE in a downtrend.

	$Trend_{UP}$	$Trend_{DOWN}$
PGR	1.237 (0.017)	0.725 (0.014)
PLR	1.079 (0.024)	0.619 (0.006)
Diff	0.218 (0.030)	0.105 (0.014)
T-Stats	7.2928	6.7932
P-Value	0.000	0.000
Sample Size	71,400	73,261

Table 15. Realised ratios on trend of the stock

	Mean	SE	T-Test	P-Value
DE $Trend_{UP}$	0.2182382	0.0299252		
DE $Trend_{DOWN}$	0.1059768	0.0156005		
Diff	0.1122614	0.0337475	3.3265	0.000

Table 16. Normalised disposition effect on trends of the stock

The next hypothesis is measuring the disposition effect based on the daily return changes.

Hypothesis 7. The disposition effect is smaller when the daily return goes up.

The null hypothesis is $DE_{Return\ UP} \geq DE_{Return\ DOWN}$ and the alternative hypothesis is $DE_{Return\ UP} < DE_{Return\ DOWN}$.

The results on Table 17 show that when the daily return drops the people realise their gains more than the days of the daily return goes up. It also causes the higher disposition effect when the daily return drops. The results in table 18 show that the sizes of the disposition effect are higher when the daily return drops. The trading patterns can be explained by the fear of having losses in invest account. People maybe wanting to achieve their profits, and they also want to avoid the situations that having losses in their account. The fear of having losses may influence investors to realise their gains more when they face the stock price drops.

	Daily Return UP	Daily Return DOWN
PGR	1.104 (0.017)	1.181 (0.020)
PLR	0.780 (0.013)	0.730 (0.011)
Diff(=DE)	0.324 (0.021)	0.451 (0.023)
T-Stats	14.99	19.56
P-Value	0.000	0.000
Sample Size	64,941	79,720

Table 17. The realised ratio on daily return changes

	Mean	SE	T-Test	P-Value
DE Daily Return UP	0.3242286	0.0216154		
DE Daily Return DOWN	0.4505445	0.0230303		
Diff	-0.1263159	0.0315851	-3.9992	0.0000

Table 18. Differences of the disposition effect on daily return changes

5.2. The Regressions

In this chapter, the panel regression is performed as an alternative method to assess the disposition effect under different conditions and with additional control variables.

5.2.1 Models

$$E(Realising\ Ratio_t) = \beta_0 + \beta_{TR}TR_t + \beta_D D_t + \beta_{TR*D}TR_t * D_t + \beta_{DR}DR_t + \beta_{DR*D}DR_t * D_t$$
$$+\beta_{KPR}KPR_t + \beta_{KPR*D}KPR_t * D_t + \beta_{Small}Small_t + \beta_{Small*D}Small_t * D_t$$
$$+\beta_{Out}Out_t + \beta_{Out*D}Out_t * D_t + \beta_{Cre}Cre_t + \beta_{Cre*D}Cre_t * D_t + u$$

Variable	Computation
TR_t = Market trend indicator	$TR_t = \begin{cases} 1 & if\ \ 20MA > 60MA \\ 0 & otherwise \end{cases}$
DR_t = Daily Return changes of stock	$DR_t = \begin{cases} 1\ if\ \ Positive\ Daily\ Return \\ 0 \qquad\qquad Otherwise \end{cases}$
KPR_t = Daily Return Changes of KOSPI (Benchmark index)	$KPR_t = \begin{cases} 1\ KOSPI\ Return\ is\ UP \\ 0 \qquad\qquad otherwise \end{cases}$
$Small_t$ = Small cap stock dummy	$Small_t = \begin{cases} 1\ SmallCapstock \\ 0 \qquad\qquad otherwise \end{cases}$
CP_t = The closed price of the stock	
RP_t = The reference price of the stock	
ΔP_t = Gaining or losing amount	$\Delta P_t\ =\ CP_t - RP_t$
D_t = Dummy for Gaining or losing	$D_t = \begin{cases} 1\ \ if\ \Delta P_t\ > 0 \\ 0\ otherwise \end{cases}$
Out_t= Number of outstanding stocks	
Cre_t= Number of credited stocks	

Table 19. The variables for the regression and the ways of constructing.

The variables are the same as the variables used for running t-test except for the market cap size variable, $Small_t$. In the regression, I compare the differences between the two groups, small-cap stocks and not small cap stocks. The total number of the observations of the large cap is 25,646, and the mid-cap is 44,192. However, the total number of the observations of the small-cap is 74,823. The numbers represent the market structure of the market cap regulation from KRX, but I decide to divide the market cap as two in order to analyse the differences between two big groups. There are 74,823 observations of the small-cap stocks and 69,838 observations of the non-small cap stocks.

There are three different types of regressors in my data. The time-varying regressors are the realised ratios (PGR, PLR), daily return changes of the stock and the number of credited stocks. The time-invariant within a year regressors are two dummy variables and one continuous variable. Two dummy variables are market cap sizes (small-cap or Not small-cap) and the trends (Upper or Lower). One

continuous variable is the total number of outstanding stocks. The values of the market cap sizes are not keeping the same values during all periods of time but change only once a year. The trends and the total number of outstanding shares are changing by time. The trends can be changed four or five times a month. The total number of outstanding shares can be changed several times a year based on the business activities such as share repurchases. There is one individual-invariant regressor, the KOSPI daily return changes. It is a dummy variable as well.

I use the fixed effect with the individual-specific effects of stocks and years for panel data analysis. There is an assumption that there is unobserved heterogeneity across the companies. One of the examples is the attention effect. Engelberg and Parsons (2011) argue that local media coverage increases the trading volume of the local traders by 37 % to 75 %. Even institutional investors are not free from limited attention. Fang et al. (2014) claim that there is a relationship between media coverage of stocks and manging the mutual funds. Thus, I am going to use an assumption that the realised ratio for the same company stock is correlated over time, but it is independent across different companies. The values of the holding are generated each year based on the number of outstanding stocks and individual's participation ratio of previous year. The level of holdings renewed yearly bases, I use the year variables as a panel as well.

In addition to the assumption, the statistical tests are done to choose the appropriate model. I run two tests for choosing between fixed effect and random effect model. The first one is Breusch-Pagan Lagrange Multiplier test and the next one is the Hausman test. The BPLM test is for testing the random effects model based on the OLS residuals. If the results of the BPLM test is significant, I need to use one of the individual-specific models instead of the OLS model and move on to the run the test for deciding whether using the fixed effect or using the random effect. The result of BPLM test is significant in 0.000 level. It means that the OLS model is not my option and run the Hausman test for choosing between fixed effect and random effect model.

If the individual-specific effects β_0 are correlated with the regressors, I need to use the fixed effect model. If it is not, I need to use the random effect model. Because the fixed effect model (FE) allows the individual-specific effect β_0 to be correlated with the regressors x, and it means that each individual company has a different intercept term at the models. The Hausman test is done for choosing the model whether the fixed effect or random effect. The result of the Hausman test is significant 0.000 level, and I choose the appropriate model for my panel data is fixed effect model.

The dependent variables and the independent variables are serially autocorrelated. I use the fixed effect model with the clustered standard errors to correct for serial correlations of my data. The clustered standard errors done by using both the Year effect and the company effect.

5.2.2 Results

The disposition effect is measured using the interaction term of variable and the dummy variable of gains. The example is that only the interaction term, β_{DR*D}, is used for interpreting the effect of the Positive Daily Return on the DE from the equation $\beta_{DR}DR_t + \beta_{DR*D}DR_t * D_t$. The value of the coefficient β_{DR} shows that PLR with positive daily return. The value of the coefficient $\beta_{DR} + \beta_{DR*D}$is the PGR when the daily return is positive. The value of the coefficient of $\beta_{DR*D}$is differences between PGR and PLR, and it makes us to examine the size of the DE.

The coefficient and the significant results on the table 20 indicate the size of DE of each variable. The full size of the regression table is in the appendix.

In order to run the robustness test and analysing the effect of the variables, I use the three different models. The variables in equation (1) are commonly using determinant factors of stock itself for trading behaviours. Investors easily look at the factors such as daily return changes, moving average on the stock charts.

The equation (2) contains the daily return changes, trends of the stock, benchmark index changes, and the market cap sizes. More factors are added in in equation (3). The equation (3) has daily return changes, stock trend, benchmark index changes, market cap sizes, the number of stocks outstanding and the number of credited stocks.

Dependent	DE	DE	DE
	(1)	(2)	(3)
Trend	0.1459359**	0.143325**	0.156618***
	(0.057994)	(0.057497)	(0.056481)
Daily Return	-0.0821797***	-0.07618***	-0.07181***
	(0.018926)	(0.018665)	(0.017567)
KOSPI Return		-0.02782	-0.03879*
		(0.020571)	(0.020535)
Small Cap Stocks		0.365777***	0.386437***
		(0.089713)	(0.086702)
Number of Outstanding Shares			7.33E-11
			(3.41E-10)
Number of Credited Shares			2.75E-07***
			(4.65E-08)
Constant	0.5861807***	0.704973***	-3.51E-01
	(0.041808)	(0.080538)	(0.628996)
Overall R^2	0.0109	0.0114	0.0220
Observations	144,661	144,661	144,661

* p < 0.1, ** p < 0.05, *** p < 0.01

Table 20. The panel regression results

This table only shows the values of the coefficient of the interaction variables, which means the amount of the disposition effect changes and the significant level. The full sizes of the regression results are in the appendix.

The regression is used for generation of the proportion of the disposition effect. If the coefficient has negative numbers, we can say that the variable decreases the size of the disposition effect. The results

are similar between two groups, both normalised and the original realised ratios. The normalised ratio is my main metrics. Thus, the regression results of normalised ratios are mainly using for interpretation and the panel regression results of the original ratios are in the appendix.

The sizes of the coefficients and a significant level are not changing between models, (1), (2), and (3). Also, the amount of the disposition effect is similar between models.

Common findings are below:

1) The stronger DE is examined when the stock has the upper trend.

The coefficients of the Trend variable are significantly higher, and it means that when the stock has upper trends, the stock has a larger DE than lower trends. The upper stock trend has a positive effect of 0.15 on average. The results are in line with the results from the t-test. The results from hypothesis 4 say that there is a significant effect, t (144,661) =3.3265, p<0.0004, with the upper trend stocks having higher DE than lower stock trends.

2) The smaller DE is measured when the daily return of the stock goes up.

The Daily Return variable has the negative effect on the sizes of the DE with one per cent significant level. It means that when the stock return has a positive return, the lower DE is examined. The results are the same as the t-test results of hypothesis 6. There is a significant effect, t (144,661) =9.513, p<0.0000, with the positive return day.

3) The smaller DE is measured when the benchmark index goes up.

The variable KOSPI Return has the negative effect on the amount of the DE, but it is not statistically significant. The values of the coefficient indicate that when the benchmark index has a positive return day, the individual stocks have lower DE. The results are the same as the t-test results of hypothesis 5. According to the t-test results, the day of positive benchmark index days have smaller disposition effect but not statistically significant, t (144,661) =-1.2716, p<0.106.

4) The larger DE is measured with the small cap sizes of stocks than large-cap size and the mid-cap stocks.

The coefficients of the Small indicate that the small-cap stocks have the bigger size of the DE than large-cap and the mid-cap stocks on average. It is statistically significant one per cent level. The results are in line with hypothesis 2.

5) The number of the outstanding shares and the number of credited stocks have a positive effect of the sizes of the DE.

The coefficients of the variables, Number of Outstanding Shares and Number of Credited Shares, are positive. The sizes of the coefficients are small, but it means that the greater number of stocks in the stock market and the credited stocks increases the amount of the DE. The coefficient of the number of stocks in the market is not statistically significant, but the amount of the credited stocks is statistically significant at one per cent level. There is no t-test result for the effect of the number of outstanding shares and the number of credited stocks.

Most of the results using the original ratios are in line with the results using the normalised ratio but only one result of using the daily return changes is not the same. It is one of the limitations and it mentioned on the limitation section.

6. Limitations

Survivorship bias may play a role in retrieved data using the API. Brown, Goetzmann, and Ross (1995) provided analysis of survival for investigating in long-term equity market returns, event-driven case studies, and other kinds of empirical research in the financial market. The retrieve data may have survival bias. The list of the stocks in KRX is the point of the view in 2018. If the stocks delisted from the exchange in 2017, it is not possible to access the data even it traded actively until 2016. Thus, 737 ordinary companies in the securities universe of my data survived in 2018. Table 21 shows that the number of stocks listed in KOSPI market including the preferred stocks and the delisted stocks including the preferred stocks. The average delisted ratio is 1.4 and it is not a big number overall market. The number of the total delisted stocks are retrieved by the Korea Investor's Network for Disclosure System (KIND).

	2012	2013	2014	2015	2016	2017	Average
Total Listed Stocks	784	777	773	770	779	774	776
Total Delisted Stocks	14	14	9	10	8	10	10.8
% of the delisted stocks	1.78	1.80	1.16	1.29	1.02	1.2	1.39

Table 21. The number of delisted stocks in KOSPI market. Source KIND.

Korea Securities Depository (KSD) is one of the public organisations as a subsidiary of the Financial Services Commission (FSC) in Korea. The KSD provides the services of deposit, virement and settlement of securities, and enhances the distribution of securities. Some companies handed over the authorities of recording the stockholders' ledger to the KSD. The holdings data of these companies are released to the public, and it contains detailed information about the stockholders. However, only 28 companies are the cases in my sample of 100 stocks. Using the holdings data from the KSD makes people possible to analyse actual holdings of the individuals. However, it can cause severe sampling biases. For example, the companies that depute the record of stockholders' ledger to KSD may have a larger size or stable earning for paying the costs. I randomly chose the sample for analysing and inferred the holdings of the individuals.

One of the assumptions is ignoring the short selling from the individual investors. Individuals are possible to do short selling in the stock market. However, naked short selling is not allowed, but only short selling by borrowing the stocks are possible. Individual's short selling is very low in Korea. Total short selling in the market is 2.75 %of daily traded volume from June 2017 until June 2018. During same periods of time, only 0.0089 per cent is individuals' short selling out of the total trading volume of individuals. It is very low, and I am ignoring the effect of short selling while I calculate the realised ratio.

The different results between normalised and original ratios are the direction of the disposition effect on the daily return changes. Using the normalised ratio, the disposition effect is smaller when the daily return goes up. However, the disposition effect is larger when the daily return goes up when the original ratio is used. It is only differences between the original and normalised ratios, and the results are closer to previous research results when the normalised ratio is used.

7. Conclusion

This paper aims to examine the individual investors' disposition effect on the stock level in the Korean stock market. The main content of this research topic is expanding the DE from the trader's account level. If the DE is unequivocally present at the account level, it can be measured at the stock level as well.

The goal of this analysis is to find an answer to the following research question:

Is the disposition effect present at the stock level in Korean Market?

Doing so, the aggregate amounts of individual investors' holdings are inferred, and trading behaviours are calculated by daily trading activities. The sampling period for this research starts from 2011untill 2017 with 1718 trading days, and 100 stocks are randomly chosen. To eliminate the external effect such as wrong rumours or financial shock, I use the two normalising factors. The one is normalising factor using traded volumes, and the other one is normalising method using the individual investors participation ratio over the entire market. Both normalising processes are constructed by comparing the previous month data.

I find that individual traders' disposition effect is present at the stock level in most of the market conditions. Realising more gains then losses are general realised patterns of individual traders. The tendency is apparent in different market-cap sizes, stock trends, benchmark index fluctuations and the daily return changes of the stock itself.

Also, I find that using the normalised realised ratio have closer results from previous research papers in Korea. Two determinant factors are supporting it. The factors are 1) the amount of the DE, 2) changes of PGR when the benchmark index has the negative return. The stronger DE is shown when the benchmark index drops then positive benchmark index day. And it is caused by the higher PGR during the negative benchmark index.

I extend the approaches to the daily return changes of the stock itself. When the stock has the negative return on day t, the stronger DE is examined. Moreover, the higher PGR is examined the same as the negative return changes of the benchmark index. Except for these two findings, the general tendencies of the disposition effect are examined in both original and normalised metrics.

The disposition effect is examined at all market cap sizes. When the market cap sizes smaller, the more disposition effect is found. It is in line with the individual's participation ratio. In Korea, there is no seasonal tax-motivated selling at the end of the fiscal year. It is the same results in other Asian countries such as Taiwan and Singapore. Because there are no tax benefits from reporting the losses in the stock market.

The higher DE is examined during the upper stock trend, which means that 20 days averaged stock price is higher than 60 days of the averaged stock price. The higher DE is examined when the benchmark index has a negative return. Also, the higher DE is examined when the stock prices are dropped than the previous closing price.

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Appendix

Variable	Observations	Mean	Std. Dev.	Min	Max
Normalised Realised Ratio	144,661	0.936061	2.915491	1.06E-05	90.15045
Original Realised Ratio	144,661	0.94692	4.885877	1.47E-05	563.769
Trend	144,661	0.493568	0.49996	0	1
Daily Return	144,661	0.448919	0.497386	0	1
Large Cap	144,661	0.177283	0.38191	0	1
Mid Cap	144,661	0.305487	0.460615	0	1
Small Cap	144,661	0.51723	0.499705	0	1
Number of Outstanding Shares	144,661	5.68E+07	9.66E+07	600000	6.66E+08
Number of the Credited Shares	144,661	465327.8	1499479	0	2.74E+07

Table 22. Descriptive statistics of the variables

	Entire sample
Total Realised Ratio	0.94692 (0.0128)
PGR	1.359442 (0.0256)
PLR	0.568331 (0.0068)
Diff (=DE_{org})	0.791111 (0.0256)
T-stats	29.7523
P-Value	0.0000

Table 23. Statistical Values of the results using original ratio

	Full Sample	Large Cap	Mid Cap	Small Cap
PGR	1.359 (0.0256)	0.728 (0.0088)	0.770 (0.0131)	1.916 (0.0484)
PLR	0.568 (0.0068)	0.613 (0.0118)	0.506 (0.0082)	0.590 (0.0117)
Diff	0.791 (0.0256)	0.114 (0.0148)	0.264 (0.0154)	1.326 (0.0498)
T-Stats	29.7523	7.7744	17.0500	26.5901
P-Value	0.000	0.000	0.000	0.000
Sample Size	144,661	25,646	44,192	74,823

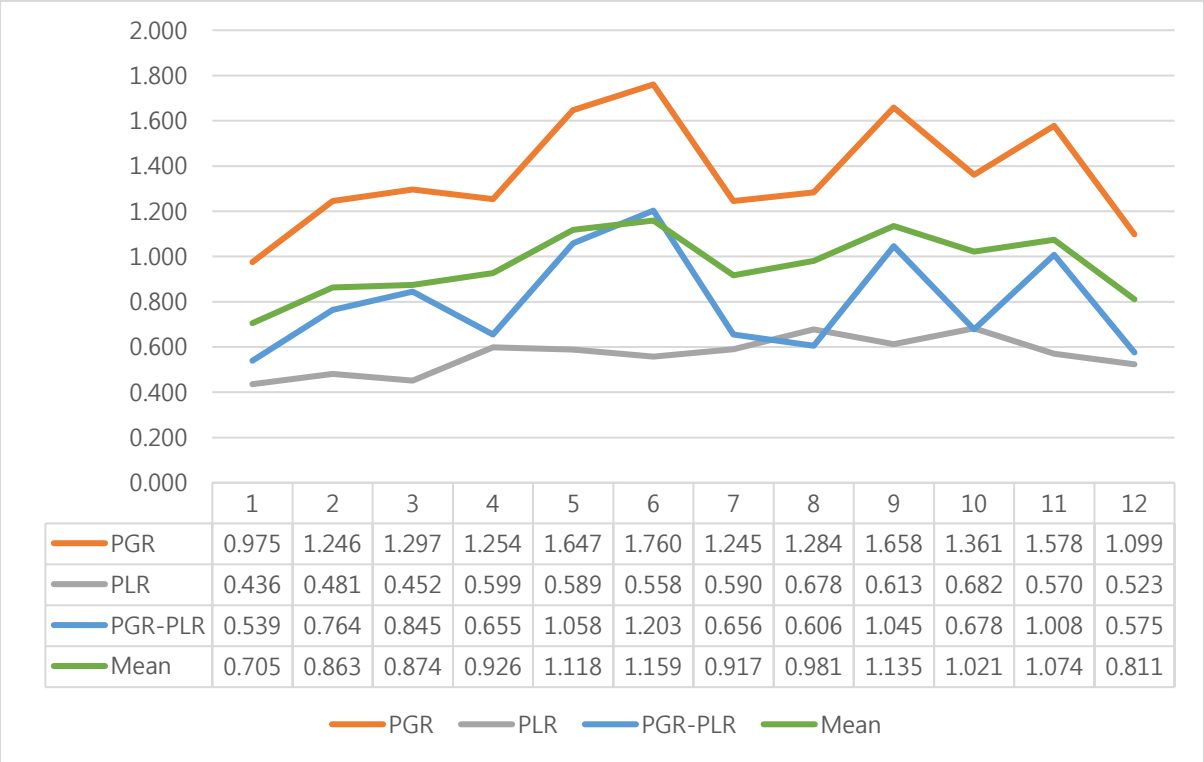
Table 24. Realised ratios over market cap sizes using original ratios

	Full Sample	Except December	December
PGR	1.359 (0.0256)	1.379 (0.0273)	1.098 (0.0520)
PLR	0.568 (0.0068)	0.572 (0.0073)	0.523 (0.0183)
Diff	0.791 (0.0256)	0.807 (0.0283)	0.575 (0.0551)
P-Value	0.000	0.000	0.000
Sample Size	144,661	132,786	11,875

Table 25. Realised ratios in December and months except December using original ratios

	Mean	SE	T-Test	P-Value
DE_{org} (=PGR-PLR) Except December	0.80704	0.02836		
DE_{org} (=PGR-PLR) December	0.57282	0.07328		
Diff	0.23179	0.06200	3.7385	0.000

Table 26. the disposition effect using original ratios



	1	2	3	4	5	6	7	8	9	10	11	12
PGR	0.975	1.246	1.297	1.254	1.647	1.760	1.245	1.284	1.658	1.361	1.578	1.099
PLR	0.436	0.481	0.452	0.599	0.589	0.558	0.590	0.678	0.613	0.682	0.570	0.523
PGR-PLR	0.539	0.764	0.845	0.655	1.058	1.203	0.656	0.606	1.045	0.678	1.008	0.575
Mean	0.705	0.863	0.874	0.926	1.118	1.159	0.917	0.981	1.135	1.021	1.074	0.811

Fig 5. The realised ratios in each month using original ratio

	KOSPI UP	KOSPI DOWN
PGR	1.363 (0.036)	1.354 (0.036)
PLR	0.564 (0.010)	0.572 (0.009)
Diff	0.799 (0.037)	0.782 (0.037)
T-Stats	21.1748	20.9461
P-Value	0.000	0.000
Sample Size	73,750	70,911

Table 27. Realised ratios on changes of the benchmark index

	Mean	SE	T-Test	P-Value
$DE_{Org,KOSPI\ UP} = PGR_{KOSPI\ UP} - PLR_{KOSPI\ UP}$	0.799306	0.037748		
$DE_{Org,KOSPI\ DN} = PGR_{KOSPI\ DN} - PLR_{KOSPI\ DN}$	0.782506	0.037358		
$DE_{Org,KOSPI\ UP} - DE_{Org,KOSPI\ DN}$	0.016800	0.053108	0.3163	0.37
$PGR_{KOSPI\ UP} - PGR_{KOSPI\ DN}$	0.00920	0.051345	0.1793	0.42
$PLR_{KOSPI\ UP} - PLR_{KOSPI\ DN}$	-0.007593	0.013736	-0.5528	0.70

Table 28. Comparing the size of the disposition effect and the realised ratios

	$Trend_{UP}$	$Trend_{DOWN}$
PGR	1.453 (0.033)	1.112 (0.033)
PLR	0.674 (0.015)	0.526 (0.007)
Diff	0.778 (0.036)	0.585 (0.034)
T-Stats	21.239	16.9715
P-Value	0.000	0.000
Sample Size	71,400	73,261

Table 29. Realised ratios on trend of the stock

	Mean	SE	T-Test	P-Value
$DE_{Org}\ Trend_{UP}$	0.77843	0.0366		
$DE_{Org}\ \ Trend_{DN}$	0.58578	0.0345		
Diff	0.1926	0.0503	3.8266	0.000

Table 30. Original disposition effect on trends of the stock

	Daily Return UP	Daily Return DOWN
PGR	1.611 (0.042)	1.063 (0.025)
PLR	0.605 (0.012)	0.547 (0.008)
Diff	1.006 (0.044)	0.516 (0.026)
T-Stats	22.77	19.34
P-Value	0.000	0.000
Sample Size	64,941	79,720

Table 31. The realised ratio on daily return changes using original ratios

	Mean	SE	T-Test	P-Value
DE Daily Return UP	1.006644	0.0440725		
DE Daily Return DOWN	0.5164589	0.0266969		
Diff	0.4901851	0.0515277	9.5130	0.0000

Table 32. Difference of the disposition effect on daily return changes using original ratios

Dependent	Realised Ratio	Realised Ratio	Realised Ratio
	(1)	(2)	(3)
Trend	0.463682***	0.465059***	0.458334***
	(0.076154)	(0.076342)	(0.074751)
D	0.136879***	-0.04025	-0.16177***
	(0.039745)	(0.044781)	(0.048934)
Trend*D	0.1459359**	0.143325**	0.156618***
	(0.057994)	(0.057497)	(0.056481)
Daily Return	0.058205***	0.061015***	0.066069***
	(0.010101)	(0.010578)	(0.010182)
Daily Return*D	-0.0821797***	-0.07618***	-0.07181***
	(0.018926)	(0.018665)	(0.017567)
KOSPI Return		-0.01357	-0.00766
		(0.012543)	(0.012302)
KOSPI Return*D		-0.02782	-0.03879*
		(0.020571)	(0.020535)
Small Cap Stocks		-0.21997	-0.21228**
		(0.163058)	(0.107787)
Small Cap Stocks*D		0.365777***	0.386437***
		(0.089713)	(0.086702)
Number of Outstanding Shares			1.22E-08
			(1.08E-08)
Number of Outstanding Shares*D			7.33E-11
			(3.41E-10)
Number of Credited Shares			7.57E-07***
			(1.38E-07)
Number of Credited Shares *D			2.75E-07***
			(4.65E-08)
Constant	0.5861807***	0.704973***	-3.51E-01
	(0.041808)	(0.080538)	(0.628996)
Overall R^2	0.0109	0.0114	0.0220
Observations	144,661	144,661	144,661

* p < 0.1, ** p < 0.05, *** p < 0.01

Table 33. The panel regression results using normalised ratio

This table shows the values of the coefficient of the whole variables in the regression model using the normalised ratio.

Dependent	Realised Ratio	Realised Ratio	Realised Ratio
	(1)	(2)	(3)
Trend	0.16207***	0.166406***	0.159009***
	(0.036432)	(0.036275)	(0.034459)
D	0.262731***	-0.24468**	-0.48733***
	(0.083848)	(0.096617)	(0.112851)
Trend*D	0.296693***	0.28982***	0.308505***
	(0.080785)	(0.07939)	(0.079182)
Daily Return	0.0443***	0.045167***	0.047607***
	(0.01619)	(0.016344)	(0.016096)
Daily Return*D	0.544121***	0.56057***	0.567812***
	(0.088371)	(0.090848)	(0.091001)
KOSPI Return		-0.00728	-0.00563
		(0.011822)	(0.011819)
KOSPI Return*D		-0.05453	-0.06423
		(0.038971)	(0.039366)
Small Cap Stocks		-0.56912***	-0.64013***
		(0.177745)	(0.146748)
Small Cap Stocks*D		1.021564***	1.114259***
		(0.197893)	(0.204055)
Number of Outstanding Shares			1.40E-08
			(1.08E-08)
Number of Outstanding Shares*D			2.87E-10
			(5.90E-10)
Number of Credited Shares			3.60E-07***
			(1.22E-07)
Number of Credited Shares *D			4.05E-07***
			(8.93E-08)
Constant	0.477884***	0.773694***	-0.14845
	(0.058479)	(0.07265)	(0.623405)
Overall R^2	0.0088	0.0111	0.0091
Observations	144,661	144,661	144,661

* p < 0.1, ** p < 0.05, *** p < 0.01

Table 34. The panel regression results using original ratio

This table shows the values of the coefficient of the whole variables in the regression model using the original ratio.