

Ko, Jim-Chen; Chang, Fu-Min; Chen, Yu-Hao et al.

## Article

# Does air pollution cause the retail investor's disposition effect in Taiwan mutual fund markets?

International Journal of Energy Economics and Policy

## Provided in Cooperation with:

International Journal of Energy Economics and Policy (IJEEP)

*Reference:* Ko, Jim-Chen/Chang, Fu-Min et. al. (2019). Does air pollution cause the retail investor's disposition effect in Taiwan mutual fund markets?. In: International Journal of Energy Economics and Policy 9 (2), S. 75 - 82.  
doi:10.32479/ijeeep.7299.

This Version is available at:

<http://hdl.handle.net/11159/3159>

## Kontakt/Contact

ZBW – Leibniz-Informationszentrum Wirtschaft/Leibniz Information Centre for Economics  
Düsternbrooker Weg 120  
24105 Kiel (Germany)  
E-Mail: [rights\[at\]zbw.eu](mailto:rights[at]zbw.eu)  
<https://www.zbw.eu/>

## Standard-Nutzungsbedingungen:

Dieses Dokument darf zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden. Sie dürfen dieses Dokument nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, aufführen, vertreiben oder anderweitig nutzen. Sofern für das Dokument eine Open-Content-Lizenz verwendet wurde, so gelten abweichend von diesen Nutzungsbedingungen die in der Lizenz gewährten Nutzungsrechte. Alle auf diesem Vorblatt angegebenen Informationen einschließlich der Rechteinformationen (z.B. Nennung einer Creative Commons Lizenz) wurden automatisch generiert und müssen durch Nutzer:innen vor einer Nachnutzung sorgfältig überprüft werden. Die Lizenzangaben stammen aus Publikationsmetadaten und können Fehler oder Ungenauigkeiten enthalten.

<https://savearchive.zbw.eu/termsfuse>

## Terms of use:

*This document may be saved and copied for your personal and scholarly purposes. You are not to copy it for public or commercial purposes, to exhibit the document in public, to perform, distribute or otherwise use the document in public. If the document is made available under a Creative Commons Licence you may exercise further usage rights as specified in the licence. All information provided on this publication cover sheet, including copyright details (e.g. indication of a Creative Commons license), was automatically generated and must be carefully reviewed by users prior to reuse. The license information is derived from publication metadata and may contain errors or inaccuracies.*



# Does Air Pollution Cause the Retail Investor's Disposition Effect in Taiwan Mutual Fund Markets?

**Jim-Chen Ko, Fu-Min Chang\*, Yu-Hao Chen, Yih-Bey Lin, Nicholas Lee**

Department of Finance, Chaoyang University of Technology, Taiwan. \*Email: [fmchang@cyut.edu.tw](mailto:fmchang@cyut.edu.tw)

**Received:** 27 October 2018

**Accepted:** 29 January 2019

**DOI:** <https://doi.org/10.32479/ijeeep.7299>

## ABSTRACT

Disposition effect is a biased behavior of investor, which sells winners too early and rides losers too long. Retail investors may have a disposition effect compared to professional investor because retail investors may lack of expertise or their psychology are affected easily by external factors, such as weather, temperature, mood, etc. Recently, Taiwan suffers from air pollution problem. Does air pollution cause the retail investor's disposition effect? By using multiple regression analysis, this article investigates the relationship between air pollution and retail investor's disposition effect in Taiwan mutual fund market. We divide the market conditions into three states, bull, bear, and neutral. Empirical results revealed that although there is no significant correlation between air pollution and the disposition effect in the overall Taiwan mutual fund market, but the retailer investor's behavior is more conservative as the degree of air pollution increases under the bull and bear markets.

**Keywords:** Mutual Fund, Disposition Effect, Air Pollution, Multiple Regression Analysis

**JEL Classifications:** E22, G40, Q53

## 1. INTRODUCTION

A mutual fund is an investment vehicle made up of a pool of money collected from many investors for the purpose of investing in securities such as stocks, bonds, and other assets. Mutual funds are operated by professional money managers, who allocate the fund's investments and attempt to produce capital gains and/or income for the fund's investors. As a result, mutual funds are favored by many retail investors. However, the way of thinking and decision are not the same in different roles, identities and positions. General speaking, professional fund managers have rich investment experiences and they are less likely to have misconceptions about investment and biased investment behavior. Compared with professional investors, the retail investors are more likely to be interfered by external factors, such as weather, temperature, mood, etc. Past studies had confirmed that most retail investors have biased investment behavior.

The disposition effect is a typical biased behavior that investors sell winners too early and ride losers too long. Several researches, such as Schlarbaum et al. (1978), Shefrin and Statman (1985), and Ferris et al. (1988), indicated that investors hold losers longer as compared to hold winners. Except for psychological factors, the atmosphere is a key factor affecting investor's mood. Bitner (1990) mentioned that planning atmosphere is the difference factor that makes the company successful or not. In addition, changes of the weather can also create different atmospheres. Many studies has confirmed that the atmosphere is related to mood of investors (Persinger [1975], McAndrew [1993]).

Recently, Taiwan suffers from air pollution problem. Exposing in the circumstances of air pollution, people are more likely to feel angry, depressed and anxious. In negative emotions, decision-making, risk aversion, and investment behavior are different. Does air pollution cause the retail investor's disposition effect in Taiwan

mutual fund markets? This paper investigates the relationship between the disposition effect of retail investors and air pollution in the Taiwan's mutual fund market. We also investigate the relationship between the disposition effect of retail investors and air pollution in different market states. We divided the market state into bull, bear, and neutral market. Moreover, we also investigate the relationship between the disposition effect of retail investors and air pollution in different types of funds.

## 2. LITERATURE REVIEW AND HYPOTHESES

By using the method of Odean (1998) to measure the disposition effect, Barber et al. (2007) took the investor transaction data from the Taiwan stock exchange to test whether the investor had a disposition effect or not. They found that the disposition effect is ubiquitous in the behavior of investors. The frequent transaction of these investors leads to increased costs. Foreign investors and mutual fund managers have no effect. Ammann et al. (2012) observed the correlation between the performance of mutual funds and the disposition effect. The authors found that a professional fund manager also has the disposition effect. In addition, it has also found that the total profit of mutual funds and the degree of disposition effect have decreased at the same time. Therefore, the authors believed that the disposition effect does not necessarily make the performance worse. Scherbina and Jin (2005) studied American mutual fund managers and the empirical results revealed that mutual fund managers have a disposition effect. Coval and Shumway (2005) investigated whether the effect of the disposition exists in the investment behavior of the Chicago futures trader or not. They used the CBOT Treasury bill futures transaction data as the sample data. They found that when futures traders produce losses in the morning and are willing to take higher risks in the afternoon, traders are not willing to sell assets to realize losses, and keep to hold assets as risk seeker. At the same time, it also verifies that the disposition effect exists in the futures market.

Kamstra et al. (2003) discussed the correlation between day length, depression, and risk aversion. They confirmed that stock market returns are affected by the length of daytime changed in the season. Such results is what we call SAD effect. Saunders (1993) studied the weather effect and its possible development and found that there was a significant correlation between the cloud volume in New York City and the return rate of stock indexes. Hirshleifer and Shumway (2003) observed a total 26 different countries from 1982 to 1997, examining the correlation between their respective major exchanges and their daily market index returns. They found that there is a significant correlation between sunshine and stock returns. The weather is a significant impact on investors' intraday trading behavior. In addition, it has been found that regardless of whether the content of information is true or not, investors who are in a bad mood are more rigorous about the handling of information. Levy and Yagil (2011) explored the relationship between air pollution and stock return. They used the air quality index (AQI) and data from four US stock exchanges, and controlled other variables to observe the correlation between air pollution and stock returns. The study found that there was a

significant negative correlation between air pollution and stock return.

Many literatures, such as Coval and Shumway (2005), Scherbina and Jin (2005), Tung (2012), Ammann et al. (2012), Barber et al. (2007), supported that investment behavior of investor have disposition effect. Therefore, this study deduces the hypotheses: The investment behavior of investors has a disposition effect in overall Taiwan mutual fund (H1). When the air pollution is serious, cloud and fog will cover the sun and reduce the viewable range, which may make seller investors increase the number of stocks they sell (Chang et al., 2008). Hence, we have the following hypotheses: Under the overall mutual fund, there is a significant positive relationship between the AQI and the disposition coefficient (H2). The mood of investor may be influenced by external environmental factors. Kamstra et al. (2003) suggested that when they feel air pollution, negative mood may arise and influence investment decisions. When investors are uncertain about risks, Loewenstein et al. (2001) pointed out that investors have a relatively conservative investment strategy and therefore inferred the investor of neutral market does not have disposition effect relative to bull and bear markets. Hence, we have the following hypotheses: there is a significant positive relationship between the AQI and the disposition coefficient under the bull and bear market (H3); there is a significant negative relationship between the AQI and the disposition coefficient under the neutral market (H4).

## 3. DATA, MARKET STATES AND RESEARCH METHODOLOGY

### 3.1. Data and Market State

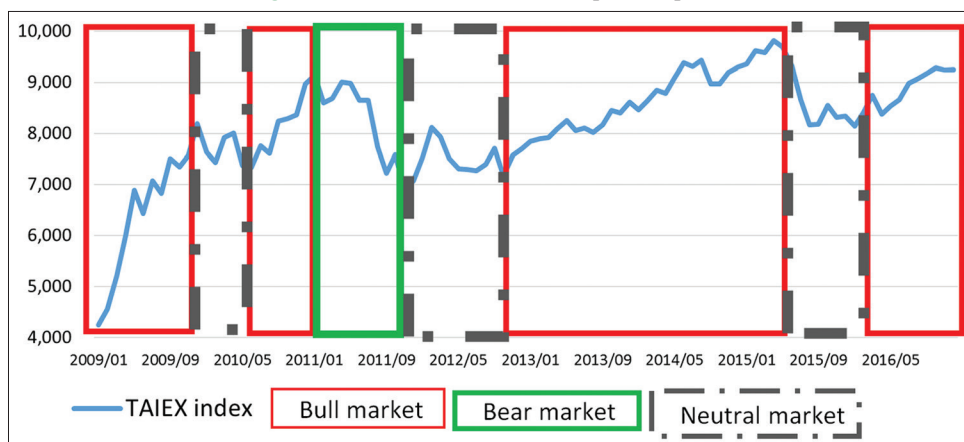
We collected the mutual fund data of Taiwan market from the Taiwan Economic Journal (TEJ), including Taiwan's domestic equity funds and balanced funds. The sample data period is from January 2009 to the end of 2017, total 147 mutual funds. The data frequency is monthly. In addition, the data for calculating the AQI are collected from the Environmental Protection Administration Executive Yuan, including sulfur dioxide (SO<sub>2</sub>), carbon monoxide (CO), ozone (O<sub>3</sub>), nitrogen dioxide (NO<sub>2</sub>), particulate matter 10 (PM<sub>10</sub>) and particulate matter 2.5 (PM<sub>2.5</sub>), carbon dioxide (CO) and nitric oxide (NO).

In this study, the market conditions are divided into three states, bull, bear, and neutral. To identify the market state, by following the method of Pagan and Sossounov (2003), the relative high and low points of the Taiwan Capitalization Weighted Stock Index (TAIEX) during from January 2009 to the end of 2017 need to be confirmed. A bull (bear) market state is a continuous uptrend (downtrend) on stock index levels, more than a 20% cumulative change range and the uptrend (downtrend) should be longer than 6 months. Besides, Katsenelson (2007) suggested that a state is called as range bound market as the fluctuation of stock index is narrow. In this study, we name such state as neutral market. Figure 1 shows the market conditions of sample data period.

### 3.2. Research Methodology

This study employs the disposition coefficient to measure the disposition effect. The disposition coefficient refers to the total

Figure 1: Market conditions of sample data period



amount of difference between the sales amount of assets gain and the sales amount of assets loss in a certain period (Weber and Camerer, 1998). The disposition coefficient  $\alpha$  is calculated as follows:

$$\alpha = \frac{S_+ - S_-}{S_+ + S_-}$$

Where  $S_+$  means the number of stocks which price rising in previous period was sold in this period and  $S_-$  represents the number of stocks which price falling in previous period was sold in this period. The value of disposition coefficient  $\alpha$  is between 1 and  $-1$ .  $\alpha > 0$  indicates that the retailer investor has a disposition effect. It means that the retailer investor sells more assets when the asset price rises;  $\alpha \leq 0$  means the retailer investor does not have the disposition effect.

In order to avoid spurious regression results, the time-series data should be ensured to stationary before performing the analysis of regression. Both Augmented Dickey-Fuller test and Phillips-Perron test are used to test the sample data. Using multivariate regression analysis, we observe whether retailer investors of mutual fund had a disposition effect or not and explore the relationship between air pollution and disposition effect of retailer investor. The regression model is as follows:

$$\alpha_{i,t} = \delta_0 + \delta_1 AQI_{i,t} + \delta_2 Red_{i,t} + \delta_3 Perf_{i,t} + \delta_4 Tover_{i,t} + \delta_5 Stdev_{i,t} + \delta_6 Lntna_{i,t} + \delta_7 NO_{i,t} + \delta_8 CO_{2i,t} + \delta_9 Temp_{i,t} + \varepsilon_{i,t}$$

The explanation of variables are listed in the following.

$\alpha_{i,t}$ : The disposition coefficient of mutual fund:

$AQI_{i,t}$ : The AQI, measuring the O<sub>3</sub>, PM<sub>2.5</sub>, PM<sub>10</sub>, CO, SO<sub>2</sub> and NO<sub>2</sub> in real time to obtain six sub-indicator values, and then take out the maximum value as the instantaneous AQI.

$NO_{i,t}$ : Nitric oxide, hourly mean ( $\mu\text{g}/\text{m}^3$ ).

$CO_{2i,t}$ : Carbon dioxide, hourly mean ( $\mu\text{g}/\text{m}^3$ ).

$Temp_{i,t}$ : Temperature, hourly mean (celsius).

$Red_{i,t}$ : The redemption rate of mutual fund.

$Perf_{i,t}$ : The annual change rate of the fund net value.

$Tover_{i,t}$ : Monthly purchase turnover rate + monthly sales turnover rate)/2;

$\delta_5 Stdev_{i,t}$ : Annualized standard deviation of funds return on investment.

$Lntna_{i,t}$ : The natural logarithm of total net assets.

$\varepsilon_{i,t}$ : Residual term.

## 4. EMPIRICAL RESULTS

### 4.1. Summary Statistics

The sample data consists of Taiwan's equity and balance funds, from January 2009 to the end of 2017. By excluding the incomplete data, total 147 funds data and total 15,876 monthly data are used. Table 1 presents the summary statistics of equity fund for the full sample data and the bull, bear and neutral markets. From the Table 1 we can see that AQI is the largest in bear market and the smallest in neutral market. Retailer investors have higher Red in bull market, indicating that retail investors sell assets actively to realize gains and losses in bull market. The bull market has the best Perf, with the widest volatility in neutral market. The Tover is the highest in bear market, indicating that fund managers are operating funds actively in bear market. The largest Stdev in neutral market represents the risk of neutral markets is higher because of uncertainty. Lntna is the largest in bear market, indicating a tendency to buy large-scale companies in bear market. The NO in bear market is the largest, and is the smallest in bull market. CO<sub>2</sub> is the largest in bull market and is the smallest in bear market.

Table 1 Summary statistics of equity fund

Table 2 presents the summary statistics of balance fund for the full sample data and the bull, bear and neutral markets. From the Table 2 we can see that the situation and the order of different markets are the same as equity fund. It means that the operation mode is similar even if the fund types are different. From Tables 1 and 2, we can observe that balanced funds have higher Red in neutral market, equity funds are higher in other markets. It means that retail investors actively sell equity funds to realize gain and loss in bull and bear markets. When the trend is unpredictable in neutral market, it tends to sell balanced funds. Regardless of market states, Perf is better in equity funds. Fund managers actively trade balanced funds in bear market, but they trade equity funds in other markets. One also can see that the risk

**Table 1: Summary statistics of equity fund**

Variables	<i>AQI</i>	<i>Red</i>	<i>Perf</i>	<i>Tover</i>	<i>Stdev</i>	<i>Lntna</i>	<i>NO</i>	<i>CO<sub>2</sub></i>
<b>Full market</b>								
Mean	79.5028	0.048	8.7819	18.17531	17.5107	14.0015	5.5729	412.5794
Median	78.4418	0.0334	8.4524	14.7375	14.6235	13.9327	5.2121	414.1753
Maximum	130.8498	0.7762	121.5038	277.81	60.8425	16.7072	9.8217	429.7133
Minimum	34.8484	0	-53.855	-10.605	4.387	11.5791	3.5585	337.2867
SD	22.7931	0.0471	21.2316	16.01756	8.74948	0.9268	1.4208	10.7972
Obs.	13608							
<b>Bull market</b>								
Mean	78.5716	0.0527	10.944	17.59237	16.5534	13.9754	5.4262	414.4343
Median	77.1782	0.0377	11.0398	14.23	12.9226	13.8979	5.1303	416.905
Maximum	130.8498	0.7762	121.5038	277.81	60.8425	16.7072	9.7826	429.7133
Minimum	34.8484	0	-53.855	-5.825	4.387	11.5791	3.5585	392.4667
SD	22.068	0.0501	19.8804	15.98813	9.32493	0.9191	1.3464	8.8041
Obs.	9450							
<b>Bear market</b>								
Mean	93.3611	0.0376	3.4659	21.80876	16.1704	14.1344	6.0467	401.1283
Median	87.724	0.0271	4.3197	18.045	16.0231	14.1095	5.8034	407.5892
Maximum	130.642	0.2826	50.5	243.75	29.3772	16.4345	7.8573	415.3383
Minimum	61.5944	0.0003	-37.19	-2.02	8.3236	11.6475	4.5446	337.2867
SD	26.4009	0.036	16.7553	18.30335	3.12163	0.9522	0.9538	21.7278
Obs.	1260							
<b>Neutral market</b>								
Mean	76.5142	0.037	4.0432	18.49644	21.2152	14.0291	5.845	411.5096
Median	75.7851	0.0235	-2.2675	15.2875	21.4823	13.9665	5.0557	410.79
Maximum	117.4314	0.4409	103.6952	189.965	43.7497	16.6121	9.8217	420.36
Minimum	39.9008	0.0003	-36.095	-10.605	7.5012	11.6594	3.5901	402.29
SD	21.3421	0.0378	25.6159	14.7907	7.3631	0.935	1.7141	4.5786
Obs.	2898							

SD: Standard deviation

**Table 2: Summary statistics of balanced funds**

Variables	<i>AQI</i>	<i>Red</i>	<i>Perf</i>	<i>Tover</i>	<i>Stdev</i>	<i>Lntna</i>	<i>NO</i>	<i>CO<sub>2</sub></i>
<b>Full market</b>								
Mean	79.5028	0.0418	6.6704	16.4838	10.3869	13.4438	5.5729	412.5794
Median	78.4418	0.0261	6.915	12.8475	9.4621	13.3807	5.2121	414.1753
Maximum	130.8498	0.6572	64.1683	93.57	31.2891	15.7633	9.8217	429.7133
Minimum	34.8484	0	-33.0241	-17.175	2.2947	11.4266	3.5585	337.2867
SD	22.7931	0.0466	12.398	13.8774	4.389	0.9728	1.4208	10.7972
Obs.	2268							
<b>Bull market</b>								
Mean	78.5716	0.0439	8.6012	15.2216	9.6051	13.4387	5.4262	414.4343
Median	77.1782	0.0288	8.3796	11.65	8.4755	13.3664	5.1303	416.905
Maximum	130.8498	0.3104	64.1683	93.57	31.2891	15.7633	9.7826	429.7133
Minimum	34.8484	0	-33.0241	-6.075	2.2947	11.4266	3.5585	392.4667
SD	22.068	0.0429	11.7165	13.6241	4.403	0.9858	1.3464	8.8041
Obs.	1575							
<b>Bear market</b>								
Mean	93.3611	0.0351	4.1423	22.2279	10.5833	13.532	6.0467	401.1283
Median	87.724	0.0189	6.2067	19.325	10.5931	13.4524	5.8034	407.5892
Maximum	130.642	0.6572	24.8	72.715	19.3736	15.4664	7.8573	415.3383
Minimum	61.5944	0.0003	-20.5186	-4.72	5.3165	11.6229	4.5446	337.2867
SD	26.4009	0.0642	10.548	15.1995	2.4432	0.9141	0.9538	21.7278
Obs.	210							
<b>Neutral market</b>								
Mean	76.5142	0.038	1.4732	18.1025	12.8505	13.4221	5.845	411.5096
Median	75.7851	0.021	-1.1826	15.63	13.0932	13.3801	5.0557	410.79
Maximum	117.4314	0.3974	55.9958	91.735	24.6855	15.4968	9.8217	420.36
Minimum	39.9008	0	-22.855	-17.175	4.0904	11.4987	3.5901	402.29
SD	21.3421	0.0485	13.5788	13.3136	4.0755	0.9547	1.7141	4.5786
Obs.	483							



**Table 3: Summary statistics of all funds**

Variables	<i>AQI</i>	<i>Red</i>	<i>Perf</i>	<i>Tover</i>	<i>Stdev</i>	<i>Lntna</i>	<i>NO</i>	<i>CO<sub>2</sub></i>
<b>Full market</b>								
Mean	79.5028	0.0471	8.4803	17.9336	16.493	13.9219	5.5729	412.5794
Median	78.4418	0.0323	8.114	14.46	13.8142	13.8556	5.2121	414.1753
Maximum	130.8498	0.7762	121.5038	277.81	60.8425	16.7072	9.8217	429.7133
Minimum	34.8484	0	-53.855	-17.175	2.2947	11.4266	3.5585	337.2867
SD	22.7931	0.0471	20.2207	15.7403	8.636	0.9536	1.4208	10.7972
Obs.	15876							
<b>Bull market</b>								
Mean	78.5716	0.0515	10.6093	17.2536	15.5607	13.8987	5.4262	414.4343
Median	77.1782	0.0365	10.5307	13.84	12.2717	13.827	5.1303	416.905
Maximum	130.8498	0.7762	121.5038	277.81	60.8425	16.7072	9.7826	429.7133
Minimum	34.8484	0	-53.855	-6.075	2.2947	11.4266	3.5585	392.4667
SD	22.068	0.0492	18.9482	15.6936	9.122	0.9477	1.3464	8.8041
Obs.	11025							
<b>Bear market</b>								
Mean	93.3611	0.0373	3.5625	21.8686	15.3723	14.0484	6.0467	401.1283
Median	87.724	0.0258	4.7071	18.135	15.4492	14.0164	5.8034	407.5892
Maximum	130.642	0.6572	50.5	243.75	29.3772	16.4345	7.8573	415.3383
Minimum	61.5944	0.0003	-37.19	-4.72	5.3165	11.6229	4.5446	337.2867
SD	26.4009	0.0412	16.0153	17.8888	3.6091	0.9697	0.9538	21.7278
Obs.	1470							
<b>Neutral market</b>								
Mean	76.5142	0.0372	3.6761	18.4401	20.0203	13.9424	5.845	411.5096
Median	75.7851	0.023	-2.0325	15.335	19.8506	13.8791	5.0557	410.79
Maximum	117.4314	0.4409	103.6952	189.965	43.7497	16.6121	9.8217	420.36
Minimum	39.9008	0	-36.095	-17.175	4.0904	11.4987	3.5901	402.29
SD	21.3421	0.0395	24.2798	14.5876	7.5767	0.9614	1.7141	4.5786
Obs.	3381							

**Table 4: Unit test results**

Variables	Test method	Test statistic		
		Include intercept	Include trend and intercept	Ordinary
$\alpha$	ADF	-14.4488***	-11.6828***	10.3796***
	PP	-14.2264***	-12.1979***	-9.63502***
<i>AQI</i>	ADF	13.3883	-6.07310**	-12.4113***
	PP	-37.2175***	-32.0175***	-6.87759***
<i>Red</i>	ADF	-60.9661***	-61.4321***	-19.3056***
	PP	-72.1849***	-69.5230***	-45.9189***
<i>Perf</i>	ADF	-18.1239***	-9.37835***	-22.9635***
	PP	-22.6612***	-14.6134***	-28.3304***
<i>Tover</i>	ADF	-41.1055***	-48.6828***	-13.8117***
	PP	-56.6180***	-60.9323***	-24.8092***
<i>Stdev</i>	ADF	-2.73594	-1.42172	-15.2620***
	PP	-1.68637	1.17984	-14.9026***
<i>Lntna</i>	ADF	4.80996	-20.6649***	-0.69502
	PP	2.96663	-21.8398***	0.03248
<i>NO</i>	ADF	-40.8991***	-56.3907***	-12.4802***
	PP	-39.5266***	-34.2067***	-8.47844***
<i>CO<sub>2</sub></i>	ADF	-55.0146***	-70.6204***	9.46598
	PP	-57.6176***	-70.6596***	16.2576

\*\*\* and \*\* denote significance at the 10%, 5% and 1% levels, respectively. ADF: Augmented, Dickey-Fuller, PP: Phillips-Perron

of equity funds was higher than balanced funds. Regardless of the states of market, the *Lntna* of equity funds is higher than balanced funds. *AQI*, *NO*, and *CO<sub>2</sub>* are consistent.

Table 3 presents the summary statistics of all funds for the full sample data and the bull, bear and neutral markets. The average *Red* is the largest in bull market and the smallest in bear market, which means that retail investors actively sell funds in bull market

and are less willing to realize gain or loss in bear market. *Perf* is the best in bull market and worst in bear market. The average *Tover* is the highest in bear market and is the lowest in bull market. It can be found that the fund managers' strategies and timing are very different and even opposite. The average *Stdev* is the largest in neutral market and is the lowest in bear market. It shows that the uncertainty of the neutral market has the highest risk. *Lntna* is the largest in bear market and is smallest in bull market. It shows that retail investors prefer

**Table 5: Unit test results after first order difference**

Variable	Test method	Test statistic		
		Include intercept	Include trend and intercept	Ordinary
<i>dAQI</i>	ADF	-64.2780***	-83.9960***	-171.999***
	PP	-101.717***	-97.5481***	-193.990***
<i>dStdev</i>	ADF	-72.5354***	-69.0981***	-108.402***
	PP	-81.7894***	-77.0420***	-133.662***
<i>dLntan</i>	ADF	-82.8824***	-79.4892***	-151.201***
	PP	-89.8509***	-86.4852***	-170.198***
<i>dCO<sub>2</sub></i>	ADF	-96.9348***	-92.7880***	-193.990***
	PP	-45.0907***	-45.0907***	-193.990***

\*\*\* and \*\*\* denote significance at the 10%, 5% and 1% levels, respectively. ADF: Augmented, Dickey-Fuller, PP: Phillips-Perron

**Table 6: T-test result of disposition effect in Taiwan mutual fund**

Disposition coefficient	Observations	average	t value	P value
$\alpha > 0$	13352	0.3433	154.5650***	0.000
$\alpha < 0$	2524			

\*\*\* and \*\*\* denote significance at the 10%, 5% and 1% levels, respectively

to buy funds in bear market, but prefer other financial instruments in bull market. AQI, NO, and CO<sub>2</sub> are consistent.

## 4.2. Unit Root Test

The results of unit root test are shown in Table 4. AQI, Stdev, Lntna, and CO<sub>2</sub> are not significant statistically. Non-stationary data have to be processed by first order difference and test again. The results after first order difference are shown in Table 5.

## 4.3. Empirical Results

Total 15,876 items of data are examined in this study. The disposition coefficient is calculated by using 12-month moving average. The disposition coefficient of 13,352 observations are  $> 0$  and the disposition coefficient of 2524 observations less than zero. Weber and Camerer (1998) suggested that when the disposition coefficient is higher than zero, it means that the investor has a disposition effect, they actively sells winner and keep holding loser. Further, we use the t-test to test the overall dispositional effect of mutual funds and obtain a statistically significant t-value. Therefore, the overall investment behavior of mutual fund retailer investors in Taiwan has a disposition effect. Hence, the hypotheses H1 is established. T-test results are shown in Table 6.

Table 7 presents the regression results in overall markets. From Table 7, we find that *dAQI* is not significant in overall market. No evidence to prove that there is a clear and direct relationship between the disposition effect of retailer investors and air pollution. Therefore, hypotheses H2 is not established. In equity market, the coefficient of all funds have the same direction and significance. The disposition effect of retailer investors increases as *Perf* increases. This shows that retailer investors are more willing to sell winner. When the fund manager trades actively, the retailer investors believe that the profitability of funds will be better. Besides, when the risk of fund increases, it causes retailer investors to actively realize gain and keep the loser. Retail investors are less likely to have a disposition effect due to large-scale fund. In balanced funds, *dAQI*, *Red*, and *dCO<sub>2</sub>* are not significant. *Perf*, *Tover*, *dStdev*, *dLntna*, and *NO* have the same coefficient direction and significant level as equity funds.

Table 8 presents the regression results of bull markets. From Table 8 we find that *dAQI* are all significantly correlated positively. The serious air pollution will make retailer investors having negative mood and increase the disposition coefficient. Under bull market, the coefficients direction and significant level of all funds and equity funds are consistent. Only *dCO<sub>2</sub>* is not significant. In balanced funds, only *NO* and *dCO<sub>2</sub>* are not significant. The difference between balanced funds and equity funds is that *Red* is a significant negative relationship in balance fund. This shows that investor have a disposition effect because of the influence of other investors when trades equity fund.

Table 9 reveals that the relationship between *dAQI* and disposition effect is positive and significant in bear market, the same as the bull market. Under the bear market, only *Red* and *dStdev* are not significant in all funds. In equity funds, only *Tover* is not significantly different from all funds. In balanced funds, only *dAQI* and *Perf* are correlated positively, and *Tover* and *dLntna* are negatively correlated. From Tables 8 and 9, we can see that there is a significant positive relationship between the AQI and the disposition coefficient under bull and bear markets. Therefore, the hypotheses H3 is established.

Table 10 shows that the significant negative relationship between *dAQI* and disposition coefficient in neutral market. The results indicates retailer investors are more risk aversion due to air pollution. Such results are the opposite with the bull and bear markets. In the neutral market, only *Red* and *Tover* are not significant in all funds. *Perf* is positively correlated. When *perf* increases, the disposition effect of investor increases. This shows that retailer investors are more willing to selling winner. *dStdev* is positively correlated. When the risk of fund increases, it will cause retailer investors to realize gain actively and keep the loser. *dLntna* is negatively correlated. Retail investors are less likely to have a disposition effect due to large-scale fund. The disposition coefficient is negatively correlated with *NO*, and is positively correlated with *dCO<sub>2</sub>*. Balanced funds are the same as all funds except that *dLntna* are not significant. According to the Table 10, there is a significant negative relationship between the AQI and the disposition coefficient under the neutral market. The regression result is same as the hypothesis. Therefore, the hypothesis H4 is established.

## 5. CONCLUSIONS

The seriousness of air pollution makes humans have to pay attention to this issue, and air pollution does affect people's

**Table 7: Regression results of overall markets**

Variables	Overall market					
	All funds		Equity funds		Balanced funds	
	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.
<i>dAQI</i>	0.0002	0.115	0.0002	0.193	0.0003	0.428
<i>Red</i>	0.2891***	0.000	0.3312***	0.000	-0.1825	0.241
<i>Perf</i>	0.0069***	0.000	0.0064***	0.000	0.0168***	0.000
<i>Tover</i>	-0.0024***	0.000	-0.0021***	0.000	-0.0043***	0.000
<i>dStdev</i>	0.0189***	0.000	0.0173***	0.000	0.0363***	0.000
<i>dLntna</i>	-0.4857***	0.000	-0.5001***	0.000	-0.5636***	0.000
<i>NO</i>	-0.0448***	0.000	-0.0478***	0.000	-0.0252***	0.000
<i>dCO<sub>2</sub></i>	0.0006**	0.015	0.0006**	0.013	0.0004	0.513
<i>C</i>	0.5652***	0.000	0.5774***	0.000	0.4549***	0.000
R-squared	0.2228		0.2281		0.3118	
Adj R-squared	0.2224		0.2276		0.3094	
F-statistic	563.4427***		497.5856***		126.7525***	
Prob (F-stat)	0.0000		0.0000		0.0000	

\*, \*\* and \*\*\* denote significance at the 10%, 5% and 1% levels, respectively

**Table 8: Regression results of bull market**

Variables	Bull market					
	All funds		Equity funds		Balanced funds	
	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.
<i>dAQI</i>	0.0009***	0.000	0.0009***	0.000	0.0010*	0.075
<i>Red</i>	0.2886***	0.000	0.3389***	0.000	-0.3525*	0.079
<i>Perf</i>	0.0071***	0.000	0.0064***	0.000	0.0185***	0.000
<i>Tover</i>	-0.0030***	0.000	-0.0027***	0.000	-0.0050***	0.000
<i>dStdev</i>	0.0243***	0.000	0.0231***	0.000	0.0324***	0.000
<i>dLntna</i>	-0.3289***	0.000	-0.3707***	0.000	-0.2237**	0.023
<i>NO</i>	-0.0285***	0.000	-0.0313***	0.000	-0.0089	0.178
<i>dCO<sub>2</sub></i>	-0.0012	0.217	-0.0010	0.364	-0.0016	0.579
<i>C</i>	0.5058***	0.000	0.5191***	0.000	0.3650***	0.000
R-squared	0.2122		0.2151		0.3224	
Adj R-squared	0.2116		0.2144		0.3189	
F-statistic	366.0042***		319.0400***		91.8990***	
Prob (F-stat)	0.0000		0.0000		0.0000	

\*, \*\* and \*\*\* denote significance at the 10%, 5% and 1% levels, respectively

**Table 9: Regression results of bear market**

Variable	Bear market					
	All funds		Equity funds		Balanced funds	
	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.
<i>dAQI</i>	0.0048***	0.000	0.0051***	0.000	0.0037**	0.029
<i>Red</i>	-0.0010	0.996	-0.0192	0.936	-0.0218	0.953
<i>Perf</i>	0.0114***	0.000	0.0111***	0.000	0.0137***	0.000
<i>Tover</i>	-0.0013***	0.003	-0.0006	0.168	-0.0070***	0.000
<i>dStdev</i>	-0.0011	0.787	-0.0008	0.837	0.0085	0.666
<i>dLntna</i>	-0.4332***	0.000	-0.2842**	0.022	-0.5355***	0.004
<i>NO</i>	0.0841***	0.000	0.0901***	0.000	0.0516	0.135
<i>dCO<sub>2</sub></i>	-0.0004*	0.091	-0.0005**	0.047	-0.0003	0.705
<i>C</i>	-0.2306***	0.000	-0.2845***	0.000	0.1358	0.509
R-squared	0.2431		0.2625		0.2576	
Adj R-squared	0.2385		0.2573		0.2246	
F-statistic	52.7562***		50.0617***		7.8067***	
Prob (F-stat)	0.0000		0.0000		0.0000	

\*, \*\* and \*\*\* denote significance at the 10%, 5% and 1% levels, respectively

feelings and behaviors. This article explored the relationship between air pollution and disposition effect of retailer investors in Taiwan's mutual fund markets. Empirical results revealed that although the overall markets does not seem to establish a significant relationship between AQI and the disposition effects,

but there are significant results in different market states. Although air pollution cannot change the behavior of investors directly, but it does cause interference to the psychological aspects of retailer investors. Besides, air pollution has a more significant impact on equity funds. The impact of air pollution is stronger in bear



**Table 10: Regression result of neutral market**

Variable	Neutral market					
	All funds		Equity funds		Balanced funds	
	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.
<i>dAQI</i>	-0.0042***	0.000	-0.0042***	0.000	-0.0046***	0.000
<i>Red</i>	0.0854	0.521	-0.0710	0.630	0.4932	0.110
<i>Perf</i>	0.0068***	0.000	0.0065***	0.000	0.0152***	0.000
<i>Tover</i>	-0.0004	0.232	-0.0004	0.245	-0.0007	0.557
<i>dStdev</i>	0.0137***	0.000	0.0133***	0.000	0.0285***	0.003
<i>dLntna</i>	-0.2387***	0.000	-0.2470***	0.000	-0.1675	0.117
<i>NO</i>	-0.0740***	0.000	-0.0775***	0.000	-0.0625***	0.000
<i>dCO<sub>2</sub></i>	0.0214***	0.000	0.0215***	0.000	0.0201***	0.000
<i>C</i>	0.6568***	0.000	0.6840***	0.000	0.5767***	0.000
R-squared	0.2936		0.3067		0.3403	
Adj R-squared	0.2919		0.3047		0.3287	
F-statistic	167.5592***		152.7867***		29.2108***	
Prob (F-stat)	0.0000		0.0000		0.0000	

\*, \*\* and \*\*\* denote significance at the 10%, 5% and 1% levels, respectively

market than in bull market, indicating that when the economy is depressed, retail investors' emotions are more likely to lose sanity due to harsh environments.

Finally, there is a significant inverse relationship between air pollution and disposition effect in neutral market, indicating that retail investors feel anxiety, when they perceived market trend is not clear, people will sell losers early to avoid serious losses. The more serious air pollution will aggravate the investor's inner anxiety.

## REFERENCES

- Ammann, M., Ising, A., Kessler, S. (2012), Disposition effect and mutual fund performance. *Applied Financial Economics*, 22, 1-19.
- Barber, B., Lee, Y.T., Liu, Y.J., Odean, T. (2007), Is the aggregate investor reluctant to realise losses? Evidence from Taiwan. *European Financial Management*, 13(3), 423-447.
- Bitner, M.J. (1990), Evaluating service encounters: The effects of physical surroundings and employee responses. *Journal of Marketing*, 54(2), 69-82.
- Chang, S.C., Chen, S.S., Chou, R.K., Lin, Y.H. (2008), Weather and intraday patterns in stock returns and trading activity. *Journal of Banking and Finance*, 32(9), 1754-1766.
- Coval, J.D., Shumway, T. (2005), Do behavioral biases affect prices? *The Journal of Finance*, 60(1), 1-34.
- Ferris, S.P., Haugen, R.A., Makhija, A.K., (1988), Predicting contemporary volume with historic volume at differential price levels: Evidence supporting the disposition effect. *The Journal of Finance*, 43(3), 677-697.
- Hirshleifer, D., Shumway, T. (2003), Good day sunshine: Stock returns and the weather. *The Journal of Finance*, 58(3), 1009-1032.
- Kamstra, M.J., Kramer, L.A., Levi, M.D. (2003), Winter blues: A sad stock market cycle. *The American Economic Review*, 91(3), 324-343.
- Katsenelson, V.N. (2007), *Active Value Investing: Making Money in Range Bound Markets*. New York: John Wiley and Sons, Inc Publishing.
- Levy, T., Yagil, J. (2011), Air pollution and stock returns in the US. *Journal of Economic Psychology*, 32(3), 374-383.
- Loewenstein, G.F., Weber, E.U., Hsee, C.K., Welch, N. (2001), Risk as feelings. *Psychological Bulletin*, 127(2), 267-286.
- McAndrew, F.T. (1993), *Environmental Psychology*. Belmont, CA, US: Thomson Brooks/Cole Publishing Co.
- Odean, T. (1998), Are investors reluctant to realize their losses? *The Journal of Finance*, 53(5), 1775-1798.
- Pagan, A.R., Sossounov, K.A. (2003), A simple framework for analysing bull and bear markets. *Journal of Applied Econometrics*, 18, 23-46.
- Persinger, M.A. (1975), Lag responses in mood reports to changes in the weather matrix. *International Journal of Biometeorology*, 19(2), 108-114.
- Saunders, E.M. (1993), Stock prices and wall street weather. *The American Economic Review*, 83(5), 1337-1345.
- Scherbina, A., Jin, L. (2005), Change is Good or the Disposition Effect Among Mutual Fund Managers. Working Paper.
- Schlarbaum, G.G., Lewellen, W.G., Lease, R.C. (1978), Realized returns on common stock investments: The experience of individual investors. *The Journal of Business*, 51(2), 299-325.
- Shefrin, H., Statman, M. (1985), The disposition to sell winners too early and ride losers too long: Theory and evidence. *The Journal of Finance*, 40(3), 777-790.
- Weber, M., Camerer, C.F. (1998), The disposition effect in securities trading: An experimental analysis. *Journal of Economic Behavior and Organization*, 33(2), 167-184.