Impact of Investor Attention from Different Search Terminals on Futures Prices

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Abstract

Using Baidu search volume index records for commodity futures market, we examine the impact of the investor attention on futures returns and the impact of investor attention from different search terminals on futures market. We find that unlike the stock market, there's no asymmetric impact of investor attention on the price in the futures market, investor attention only impact on magnitude of futures prices instead of direction. When search volume index is used as a proxy for investor attention, the impact on future price is decided by PC-based search index, while search volume index from the mobile terminal have more characteristic of noise trading.

Keywords: Investor attention, Mobile-based search volume, commodity futures returns

1 Introduction

In the behavioral finance, investor attention has been an interesting topic for researchers. However, in early researches on investor attention, the variables involved simply add to asset exposure without directly judging whether there's investor attention. Today, the search engine represented by Google has become an important means of obtaining information; while offering great convenience, search engines retain traces of people's searching for information. By using these traces, like the search records left on search engines, we may find solutions to the existence of proxy variable found in traditional researches of investor attention.

According to the research by Da and Engelberg et al. (2011), the search volume index (SVI) which generated by people searching the stock on Google can be used as a proxy variable of investor attention. Dimpfl and Jank (2016), the investor attention having search volume as the proxy variable will cause the rise of stock volatility. Ding and Hou (2015) believe that the investor attention having search volume as proxy variable will significantly enlarge the cardinal number of investors and increase stock liquidity. As for financial markets beyond the stock market, researches making SVI as the proxy variable for investor attention are relatively small in number, which may be attributed to the fact that SVI mainly reflects the attention of retail investors while the stock market features higher-level participation of retail investors compared with other

markets. Goddard and Kita et.al (2015) argues that in the foreign exchange market, investor attention is a risk source of pricing in the market, and there are significant differences in the meanings of future market and stock market as to the target of trade, as well as in the structure of investors and investors' trading habits. Therefore, whether the conclusion about investor attention in the stock market is applicable to the futures market is the target of our research.

Barber and Odean (2011) studies the investment behaviors of individual investors, pointing out that the purchase decisions of individual investors are greatly impacted by limited investor attention and past stock return. The conclusion explains why investor attention has positive impact on short-term stock return in many researches. In the stock market, compared with going short, going long better accords with investment habits and proves to be more convenient, so that investors will be easily impacted by investor attention in making purchase decisions and will tend to buy the stocks that catch their attention and sell stocks that they already hold. Therefore, in the stock market, investor attention will have an asymmetrical impact on retail investors. Due to market differences, investors' awareness and convenience of going short in the futures market will be much higher than in the stock market; in such a market where buying and selling are balanced, whether the investor attention having SVI as the proxy variable will have an impact on futures return similar to that on the stock return is the target of our research.

In early researches in which the search volume based on Internet search engines was made investor attention, the Internet search volumes used are usually Google trend data, and the index was formed based on the times of keyword be searched on the Internet. This index didn't show demands from different search terminals. Kamvar and Baluja (2006) argue that there're great differences between Google users who search on mobile devices and those who search on PC devices. Compared with PC users, mobile device users clearly enter words of shorter length; and the number of mobile device users who click on links to jump is small, and such users tend to click on links ranking top. They believe it's probably because users will have more difficulties in mobile searching and the screen of mobile device will display very limited information. Kamvar and Kellar et al. (2009) point out that due to the absence of uniform display port, there're differences in the searching behaviors on mobile devices. Researche of Dyson and Haselgrove (2001) et al. show that on the screen, a moderate line length (about 55 characters each line) under normal reading speed will equip readers with better comprehension ability. Obviously, the mobile device with a smaller screen will have to downsize the character or reduce the line length, which will reduce the readability of texts anyway. Church, Smyth and Cotter (2007) point out that mobile searching clearly indicates an alteration rate higher than PC searching, and mobile search users will improve previous contents input to get better search results. Researches above on mobile searching behaviors have all shown that mobile search users cannot compete with PC users as for the process of searching and the number of results obtained, as well as readability. And the user of search engine also have the similar behavior characteristics in Chinese. (Wang and Li et.al, 2013) Therefore, we believe that investors who use mobile search will be more unlikely to make correct judgments as to the information compared with investors who use PC search. And investment behaviors that utilize incorrect information or cannot achieve correct comprehension of information coincide with the characteristics of noise traders. (Black, 1986) We've found that investor attention from different terminals features heterogeneity; PC-based investor attention will impose more favorable impact on the market, mostly reflected in unified impact on the price and no obvious increase of turnover rate, while mobile-terminal-based investors tend to show the

impact of noise trading in their market performance, mostly reflected in no obvious impact on the price and evident increase of turnover rate. Therefore, we extend Da's (2011) theory by believing that among the impacts of SVI on asset price, the PC-based SVI plays a decisive role, while mobile-terminal-based SVI is mostly represented by noise trading and no obvious impact on asset price. Media news index can't be used as a proxy variable of investor attention on future market.

Overall, we propose the following hypotheses:

Hypothesis 1 (H1): Investor attention has a positive impact on the excess return of stocks, which is only applicable to the asymmetric market, however, is not applicable to asymmetric market represented by the futures market. In a symmetric market, investor attention will have an impact on the scale of futures price but it's hard to determine the orientation of asset change.

Hypothesis 2 (H2)*:* Using media news index as proxy variable of investor attention not have impact on future's return or scale of future's price change

Hypothesis 3 (H3)*:* Investor attention from PC terminal obviously affects the scope of futures price change of the next day. By contrast, mobile-based investor attention clearly impacts the scope of futures price change of that day but has no effect on the scope of price change for the next day.

Hypothesis 4 (H4)*:* PC-based investor attention has no obvious impact on the next day's turnover rate. However, mobile-based investor attention has an impact on the turnover rate at next day.

The rest of the paper is organized as follows. Section 2 explain the reason for select the data sources and describes our data. In Section 3, we establish the empirical models according to hypothesizes. Section 4 examines the models and explain the result. Section 5 is summary and conclusion.

2 Data

2.1 Why China's soybean meal futures market is chosen for the research

The previous researches on investor attention based on search volumes make Google trend the data source of search volumes. (see Bank and Larch et al., 2011; Da and Engelberg et al., 2011; Da and Engelberg et al., 2014; et al.) The research intends to study the impact of search volumes from different search terminals on the financial market, but Google trend cannot tell the differences between search volumes from different terminals. Baidu Index Service promoted by Baidu is similar to Google trend, but the former manages to differentiate search volumes from different terminals, so the research will use Baidu index service to replace Google trend, which is widely used in previous researches, as the data source of search volumes.

As China′s largest search index, Baidu also has a certain degree of influence around the globe. In 2014, the market share of Google in the globe was about 68% while that of Baidu was 18% for the same day. (See CNZZ data center) In the Chinese market, the market share of Baidu is 56%, and as the largest Chinese search engine, Baidu shows great influence from China, so that we have every reason to believe that the data from Baidu are fully reliable in the data range, the quality and the reliability. (CNNIC) As Baidu mainly serves Chinese users, this research chooses Chinese market as the target.

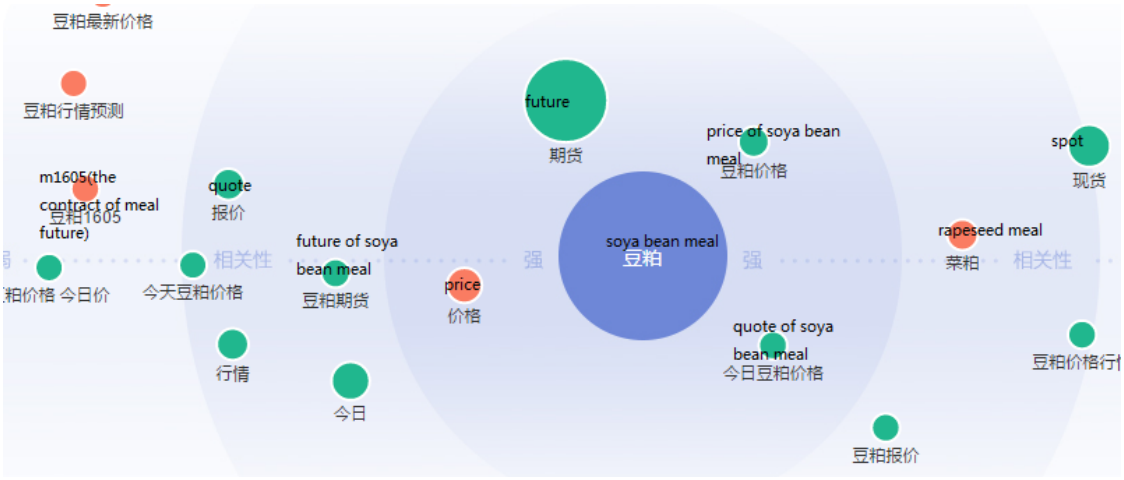

Figure 1. The search trends of related keyword “soya bean meal”

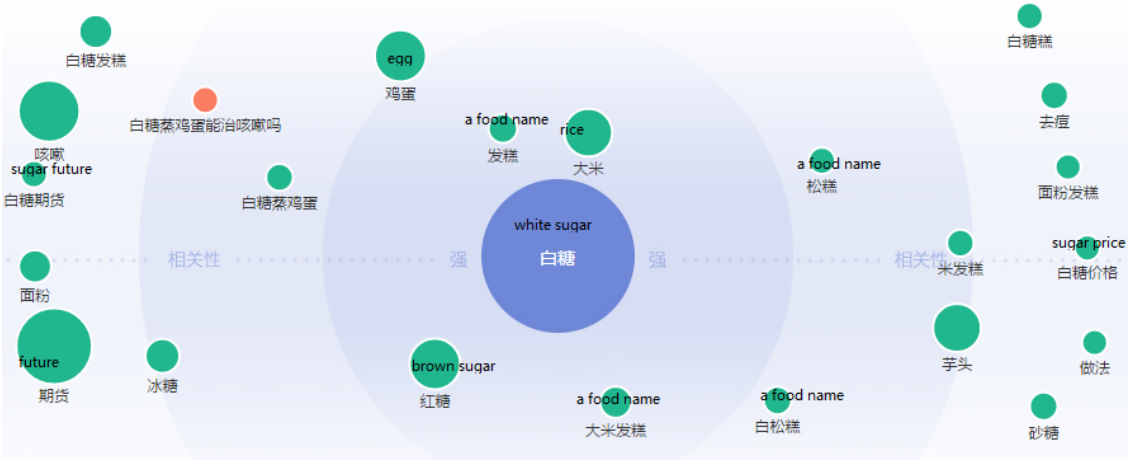

Figure 2. The search trends of related keyword “white sugar”

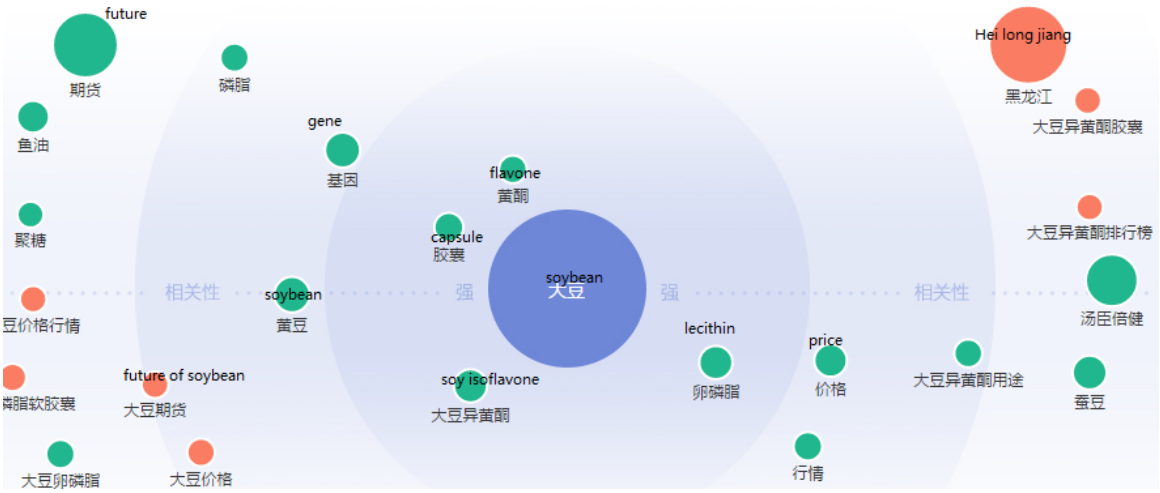

Figure 3. The search trends of related keyword “soya bean”

**The above three figures show the related words which keywords are soybean meal, sugar, soybean from Baidu Index. In the picture, the rounds mean the keywords, the size of round means the search volume (The bigger round means the keyword have higher search volume), and the distance of two round means degree of correlation between two words. (The shorter distance means stronger relation between two keywords)*

Previous researches are mainly about the relationship between search volumes and the stock market, but Baidu′s control of search results makes it unlikely to release all search information of the stock market. Therefore, the incomplete data of the stock market made us choose the futures market as our research object. In the Chinese market, the soybean meal futures product in Dalian Commodity Exchange has wide influence in the future market, and so far the amount of soybean meal futures in the exchange turns out to be No.1 in the world, (see The Development Report on China's Futures Market) and as the main producer and consumer of soybean meal, China shows strong impact in both the futures market and the spot market. Meanwhile, soybean meal, as a principal raw material of fodder, is not very much consumed by average people, so that its search result will show smaller noise compared with that of other futures products and will better reflect investor attention to the futures.

As shown in Figure 1-Figure 3, the keywords related to searches about soybean meal are directly related to the futures like "Future", "The price of soybean meal", "The quote of soybean meal" and "The future of soybean meal", while the searches about products are mostly focused on non-futures. (The related searches of the white surge is "Rice", "Egg" and "Fagao" (A kind of Chinese food). And the related searches of soybean is "Capsule", "Flavone", "Lecithin" and "Gene"). Meanwhile, search volumes are believed to reflect investor attention of retail investors, soybean meal futures is a product in which individual investors show a high degree of participation, and individual investors will exert corresponding effects in the soybean meal futures market. Based on the reasons abovementioned, China′s soybean meal futures contract is an ideal research object.

2.2 Data Collection and Sample Construction

As the life cycle of a single futures contract cannot fully cover the sample range, the paper makes some treatment to soybean futures contract to form a dominant contract sequence of soybean meal that covers the whole sample range. The specific way is: to select the contract featuring the largest positions in each trading day as the dominant contract for the day, and the closing price of the dominant contract for the trading day shall be arranged by chronological order to form a dominant contract price sequence of soybean meal futures. A similar way was applied to the US soybean meal futures price sequence. Thus, the price sequences of Chinese future market and foreign futures markets, combined with soybean meal spot market prices and Baidu search index data on each trading day included in the sample range, manage to form complete data sets.

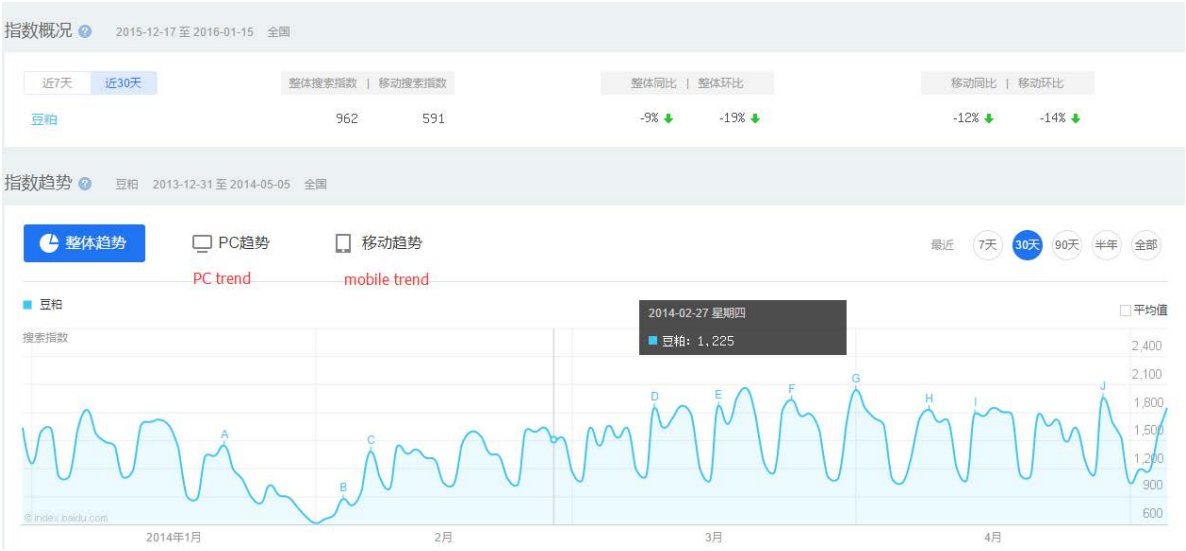

Figure 4. Baidu Index Search

**The search volume index appears a periodicity. Obviously, there is higher search volume index on trading day than non-trading day. In this web page, you can select "PC trend" and "mobile trend" to view the PC-based SVI and mobile-based SVI*

Baidu index service provides us with an index of search times of a certain keyword. Similar to Google trend, the service reflects the relative search times of a keyword as shown in Figure 4. The difference lies in that Baidu Index Service subdivides the search index of the keyword according to different terminals which make a searching request, dividing the search index into PC search index and mobile search index. Quantitatively, Baidu search volumes index are the sum of PC search volumes index and mobile search volumes index. Meanwhile, the service also offers Baidu media index (MVI), which reflects the relative times of keywords being used in the headlines of media coverage. Baidu media index reflects the media's exposure of keywords, similar to the times of keywords showing up in newspaper front pages which are used as a proxy variable of investment attention in other researches of investor attention. (Da and Engelberg, 2011) The difference is that Baidu media index reflects investor attention in online media news but not on traditional print media.

3 Empirical methodology

Firstly, we'll discuss whether investor attention exerts the same effect on the futures market and the stock market. Previous research conclusions focused on the stock market are based on the hypothesis (Barber and Odean, 2008) that individual investors in the stock market are net buyers of the stocks they pay attention. (Chan, 2003; Aboody and Lehavy et al., 2010; Chemmanur and Yan, 2010; Hirshleifer and Lim et al., 2011; Engelberg and Sasseville et al., 2012; Hirshleifer and Lim et al., 2011) We must test whether such conclusions are still workable in the futures market. It should be noted that in the stock market, individual investors will mostly buy in stocks for trading, then sell them for returns when the time is ripe. That means stocks of higher attention will enjoy greater opportunities of being bought in by investors, hence rising share price in a short term; however, a similar effect will not be shown during selling, because individual investors will only

be concerned with the positions they hold when selling stocks, so the effect on stocks of high attention for selling will be smaller than that for buying; or rather, the impact of investor attention on the price in the stock market is asymmetric. In the futures market, individual investors can easily start a transaction by a sell order and hold short positions until close it by a buy order to finish a transaction (investors who choose physical delivery to close transactions are usually enterprise investors, while search volumes are deemed to reflect the investor attention of individual investors, so the investors who resort to physical delivery are not included in this research). Therefore, it's open to doubt whether the asymmetric effect of investor attention in the stock market would occur in a market like the futures market that accepts both "buy to open" and "sell to open". We'll apply the following model in order to verify the hypothesis.

$$R_{f,t} = \beta_1 SVI_t + \beta_2 R_{s,t} + \beta_3 R_{a,t} + \sum_{i=1}^{n} \beta_{4i} R_{f,t-i} + \varepsilon \qquad (1)$$

Where,

$R_{f,t}$= the return of Chinese soybean meal future during day t;

SVI_t=Search Volume Index during day t; Aggregate search frequency from Baidu Index based on the soybean meal futures;

$R_{s,t}$=the return of Chinese soybean meal spot during day t;

$R_{a,t}$= the return of American soybean meal future during day t

$R_{f,t-i}$= the return of Chinese soybean meal future during day t-i.

If β_1 in Formula (1) is obviously not zero, it means the search volumes have an evident effect on the futures return of that day, or it'll mean that the search volumes have no marked effect on the futures return of that day.

Similarly, we may use the following model to verify whether the search volumes have obvious effect on futures return of the next day.

$$R_{f,t+1} = \beta_1 SVI_t + \beta_2 R_{s,t} + \beta_3 R_{a,t} + \sum_{i=0}^{n} \beta_{4i} R_{f,t-i} + \varepsilon \qquad (2)$$

If β_1 in Formula (2) is obviously not zero, it means the search volumes have an evident effect on the futures return of the next day, or it'll mean that the search volumes have no marked effect on the futures return of that day.

$$FR_{f,t} = \beta_1 SVI_t + \beta_2 FR_{s,t} + \beta_3 FR_{a,t} + \sum_{i=1}^{n} \beta_{4i} FR_{f,t-i} + \varepsilon \qquad (3)$$

$$FR_{f,t+1} = \beta_1 SVI_t + \beta_2 FR_{s,t} + \beta_3 FR_{a,t} + \sum_{i=0}^{n} \beta_{4i} FR_{f,t-i} + \varepsilon \qquad (4)$$

Where,

$FR_{f,t}$= the absolute return of Chinese soybean meal future during day t;

$FR_{s,t}$=the absolute return of Chinese soybean meal spot during day t;

$FR_{a,t}$= the absolute return of American soybean meal future during day t;

$FR_{f,t-i}$= the absolute return of Chinese soybean meal future during day t.

Due to the characteristics of the futures market that accepts both buy to open and sell to open. Whether price rise or price fall will guarantee investors' earnings in a correct direction, so here we'll define the absolute value of the return as futures market return. By using the return of absolute value, we'll review the effect of search volumes on futures market return.

Most of the previous researches have shown that the investor attention that uses the times that

keywords show up on newspapers' front pages as a proxy variable has a positive impact on the excess return of stocks. (Grullon and Kanatas et al., 2004) Da also explains in his research that the news media index provided by Google trend can be used as a substitute for the occurrence numbers of keywords on newspaper front pages. However, the futures market, as a relatively professional market, would be strange for most individual investors and there're fewer media reports about them. (Fang and Peress, 2009) Generally, it's only when related markets have significant fluctuations will the media make market fluctuation the topic of news coverage. Therefore, it's a topic we need probe into whether using the news media index on the Internet as a proxy variable for investor attention will exert an impact in the futures market similar to that in the stock market. We'll utilize the following models to verify the impact of investor attention having Internet media index as a proxy variable on the futures market. We shall consider using SVI, spot return, foreign futures markets return and the lagged variable of Chinese soybean meal futures return of Day t as control variable to study Internet Media Index of the day on Chinese soybean meal futures return of Day t and Day t+1, as shown in Formulas (5) and (6) as follows:

$$R_{f,t} = \beta_1 SVI_t + \beta_2 R_{s,t} + \beta_3 R_{a,t} + \sum_{i=1}^{n} \beta_{4i} R_{f,t-i} + \beta_5 MVI_t + \varepsilon \quad (5)$$

$$R_{f,t+1} = \beta_1 SVI_t + \beta_2 R_{s,t} + \beta_3 R_{a,t} + \sum_{i=0}^{n} \beta_{4i} R_{f,t-i} + \beta_5 MVI_t + \varepsilon \quad (6)$$

Where,

$R_{f,t}$= the return of Chinese soybean meal future during day t;

SVI_t= Search Volume Index during day t; Aggregate search frequency from Baidu Index based on the soybean meal futures;

$R_{s,t}$= the return of Chinese soybean meal spot during day t;

$R_{a,t}$= the return of American soybean meal future during day t;

$R_{f,t-i}$= the return of Chinese soybean meal future during day t-i;

MVI= Internet Media Index, and its coefficient β_5 is used to judge the impact of Internet Media Index on Chinese soybean meal futures return and the absolute return during day t and day t+1.

Similarly, we'll have to test the impact of Internet Media Index on the absolute value of Chinese soybean meal futures return, as shown in Formulas (7) and (8) as follows:

$$FR_{f,t} = \beta_1 SVI_t + \beta_2 FR_{s,t} + \beta_3 FR_{a,t} + \sum_{i=1}^{n} \beta_{4i} FR_{f,t-i} + \beta_5 MVI_t + \varepsilon \quad (7)$$

$$FR_{f,t+1} = \beta_1 SVI_t + \beta_2 FR_{s,t} + \beta_3 FR_{a,t} + \sum_{i=0}^{n} \beta_{4i} FR_{f,t-i} + \beta_5 MVI_t + \varepsilon \quad (8)$$

Where,

$FR_{f,t}$= the absolute return of Chinese soybean meal future during day t;

$FR_{s,t}$= the absolute return of Chinese soybean meal spot during day t;

$FR_{a,t}$= the absolute return of American soybean meal future during day t;

$FR_{f,t-i}$= the absolute return of Chinese soybean meal future during day t;

MVI= Internet Media Index, and its coefficient β_5 is used to judge the impact of Internet Media Index on Chinese soybean meal futures return and the absolute return during day t and day t+1.

After verifying the impact of search volumes on the futures market, we'll subdivide the search volumes. The sources of searching requests received by the search engine are respectively PC and mobile phone. We believe searching requests of different sources will have different effect on the market. We shall utilize the following models to test the searching requests from different

terminals on futures price.

$$FR_{f,t} = \beta_{11} SVI_{pc,t} + \beta_{12} SVI_{m,t} + \beta_2 FR_{s,t} + \beta_3 FR_{a,t} + \sum_{i=1}^{n} \beta_{4i} FR_{f,t-i} + \varepsilon \quad (9)$$

$$FR_{f,t+1} = \beta_{11} SVI_{pc,t} + \beta_{12} SVI_{m,t} + \beta_2 FR_{s,t} + \beta_3 FR_{a,t} + \sum_{i=0}^{n} \beta_{4i} FR_{f,t-i} + \varepsilon \quad (10)$$

Where,

$FR_{f,t}$= the absolute return of Chinese soybean meal future during day t;

$FR_{s,t}$= the absolute return of Chinese soybean meal spot during day t;

$FR_{a,t}$= the absolute return of American soybean meal future during day t;

$FR_{f,t-i}$= the absolute return of Chinese soybean meal future during day t;

$SVI_{pc,t}$= Search Volume Index from PC;

$SVI_{m,t}$= Search Volume Index from mobile phone.

By testing β_{11} and β_{12} in the two formulas, we can analyze the impact of PC-based search volumes and mobile-based search volumes on the absolute return value in the futures market for the day and the next day.

The reason why the search volumes from different search terminals on the change of return on assets will exert different impacts is probably the searching behaviors of individual investors using different search terminals and their different abilities in handling search results. To go further, it's harder for individual investors searching via mobile terminal to conduct all-round and exact collection and judgment as to the information, while using incomplete, incorrect and not correctly understood information for investment decision-making coincides with the trading characteristics of noise trader. (Wang, 2010) Therefore, we'll use the following models to verify the relationship between search volumes from different terminals and noise trading:

$$TU_t = \alpha + \beta_{11} SVI_{pc,t} + \beta_{12} SVI_{m,t} + \beta_2 FR_{s,t} + \beta_3 FR_{a,t} + \beta_4 FR_{f,t} + \sum_{i=1}^{n} \beta_{5i} TU_{t-i} + \varepsilon \quad (11)$$

$$TU_{t+1} = \alpha + \beta_{11} SVI_{pc,t} + \beta_{12} SVI_{m,t} + \beta_2 FR_{s,t} + \beta_3 FR_{a,t} + \beta_4 FR_{f,t} + \sum_{i=0}^{n} \beta_{5i} TU_{t-i} + \varepsilon \quad (12)$$

Where,

$TU_t = Vol_t / Pos_t$, TU_t means the turnover rate of the day t;

Vol_t= volume during day t;

Pos_t= position during day t;

$FR_{f,t}$= the absolute return of Chinese soybean meal future during day t;

$FR_{s,t}$= the absolute return of Chinese soybean meal spot during day t;

$FR_{a,t}$= the absolute return of American soybean meal future during day t;

$SVI_{pc,t}$= Search Volume Index from PC;

$SVI_{m,t}$= Search Volume Index from mobile phone.

In the models, we utilized Chinese market spot, foreign futures markets and return change of Chinese market futures as control variables to study the impact of search volumes from PC and mobile terminal on the turnover rate. In the futures market, a higher turnover rate will mean more intraday trades not aimed at position holding in the market and richer atmosphere of speculation. And with the return range in the Chinese market controlled, if the search volumes can still have marked effect on the turnover rate, it means under the same circumstance of futures price change, there're more intraday trades not aimed at position holding, meaning that more trades don't

actually affect price change, so that we believe there're more noise trades at this moment. In this part, we'll test β_{11} and β_{12} in the two formulas to verify the effect of search volumes from different terminals on noise trades.

4 Empirical Results

4.1 Impact of search volume on return

We tested whether the asymmetric effect of investor attention shown in the stock market also occurs in the market that accepts both "buy to open" and "sell to open" like the futures market. The model test results of Formula 1 and Formula 2 are shown in Table 1. It can be seen from the test result of Formula 1 that the spot return during day t, the foreign futures market return of day t and day t-1 all have a marked impact on the futures return of the day. However, Baidu search index has no obvious impact on futures price. It can be seen from the test result of Formula 2 that the foreign futures markets and futures return of that day have marked impact on the futures return of the next day, while the spot return and Baidu search index of that day show no evident impact. It can be seen from the results of Table 1 that in a market that accepts both "buy to open" and "sell to open" like the futures market, the search volumes will not have marked impact on futures return. Therefore, the conclusion that the increase of search volumes will obviously enhance the abnormal return of assets, which is based on the hypothesis that individual investors are net buyers of the stocks that attract their attention, is only applicable to a market that accepts only "sell to open" like the stock market. For a market that accepts both "buy to open" and "sell to open" like the futures market, as it's impossible to determine the directivity of investor attention and to determine whether the occurrence of attention is attributed to positive or negative information, it'll be also impossible to exert an impact on a fixed direction on asset price. Thus, the search volumes will have no marked impact on futures return, either for Day t or Day t+1. The factor that exerts obvious impact is still the returns of underlying assets.

Table 1 The Influence of SVI on futures return

	$R_{f,t}$	$R_{f,t+1}$
SVI_t	-0.004	0.001
$R_{s,t}$	0.332**	0.061
$R_{a,t}$	0.129**	0.321**
$R_{f,t}$	-	-0.215**
$R_{f,t-1}$	-0.241**	0.028
$R_{f,t-2}$	0.024	-0.073*
$R_{f,t-3}$	-0.076*	-0.062
$R_{f,t-4}$	-0.095*	0.092*
$R_{f,t-5}$	0.091*	-
R^2	0.162**	0.142**

* and ** represent significance at the 5% and 1% levels respectively.

Then we tested the models in Formula 3 and 4, with the result shown in Table 2. It can be seen from Table2 that by replacing the return by absolute return value, with the return directivity removed, the search volumes have obvious impact on the absolute return value. Meanwhile, the absolute return values of spots on Day t and t-1 futures have marked impact on the absolute return value of futures on Day t. However, the absolute return value of foreign futures markets for Day t has no marked impact on the futures price of Day t. In the third column of table 2, we tested the impact of these variables on the absolute return value of futures for Day t+1. It can be seen that search volumes also show significant impact; however, different from the impact on Day t, the spot for Day t has not marked impact on the absolute return value of futures on Day t+1, but the absolute return value of foreign futures markets on Day t has evident impact on the absolute return value of futures on Day t+1.

By removing the directivity of the return, we can find out that search volumes have marked impact on the absolute return value of futures during both Day t and Day t+1. Firstly, it indicates that higher investor attention will extend the range of asset price change. Secondly, with individual investors showing greater attention to the futures market, they tend to make relatively consistent judgment as to asset price, hence impact on the asset price in one direction but not trades in an opposite direction due to investors' different understandings of the information after the attention rises, which subsequently offsets the impact of investor attention on the scope of asset price change.

While in Table2, the reason why spot market for Day t has obvious impact on futures for Day t but the foreign futures markets for Day t have no impact on futures for Day t is probably that the foreign futures markets for Day t utilize the US soybean meal futures, with a trading time lagging about 12 hours behind Chinese futures trading. That is to say, the foreign futures markets trading for Day t takes place later than Chinese futures trading for Day t but earlier than Chinese futures trading for Day t+1. This explains why the absolute return value of foreign futures markets for Day t has marked impact on the absolute return value of futures for day t+1.

By comparing Table 1 and Table 2, it's not hard to find that in a market that accepts both "buy to open" and "sell to open" like the futures market, search volumes don't show an asymmetric effect on the return as can be seen in a market that accepts only "sell to open" like the stock market. As the search volumes cannot differentiate the tendency of attention, there's no obvious impact of search volumes on return on assets, but that doesn't mean that search volumes have no effect on asset price at all. It can only be confirmed that search volumes have marked impact on the absolute return value of futures, and the increase of investor attention markedly impact the scope of asset price change.

Table 2 The Influence of SVI on futures absolute return

	$FR_{f,t}$	$FR_{f,t+1}$
SVI_t	0.287**	0.288**
$FR_{s,t}$	0.169**	0.013
$FR_{a,t}$	0.037**	0.111**
$FR_{f,t}$	-	0.232**
$FR_{f,t-1}$	0.207	0.005
$FR_{f,t-2}$	0.012	0.045
$FR_{f,t-3}$	0.037	0.191**
$FR_{f,t-4}$	0.186**	-0.035
$FR_{f,t-5}$	-0.050	-
R^2	0.513	0.493**

* and ** represent significance at the 5% and 1% levels respectively.

In this section, we need to test the impact of the investor attention having Internet Media Index as the proxy variable on the Chinese soybean meal futures market. The test results of Formula (5) and Formula (6) are shown in Table 3. Table3 demonstrates the impact of Internet Media Index on the futures return for Day t and Day t+1. Here all the variables in Formula (1) are used as control variables in order to observe the impact of Internet Media Index on futures return. It can be seen from Table 3 that similar to the result of Table 1, neither SVI nor MVI has a marked impact on the futures returns for Day t and Day t+1. The reason is generally the same: SVI and MVI are both to measure the proxy variable on the aspect of the investor from different angles. Due to the symmetry of trading direction in the futures market, there's no asymmetric effect of investor attention on the return on assets that's seen in the stock market. The result of Table 3 also intensifies the previous conclusion that investor attention has no evident impact on the return of the futures market.

Table 3 The Influence of MVI on futures return

	$R_{f,t}$	$R_{f,t+1}$
SVI_t	-0.022	-0.036
MVI_t	0.021	0.041
$R_{s,t}$	0.331**	0.059
$R_{a,t}$	0.130**	0.322**
$R_{f,t}$	-	-0.215**
$R_{f,t-1}$	-0.241**	0.027
$R_{f,t-2}$	0.024	-0.074
$R_{f,t-3}$	-0.076*	-0.062
$R_{f,t-4}$	-0.096*	0.091*
$R_{f,t-5}$	0.090*	-
R^2	0.172**	0.154**

* and ** represent significance at the 5% and 1% levels respectively.

The results of Formula (7) and Formula (8) are shown in Table 4. Table4 demonstrates the impact of Internet Media Index on the absolute return value of futures for Day t and Day t+1. Here variables from Formula (3) and Formula (4) are used as control variables, but the difference is that

MVI, also serving as a proxy variable for investor attention, doesn't have an obvious impact on the absolute return value of futures for Day t and Day t+1. The result is somehow different than that on the stock market. Reasons for such a situation may be that futures market is relatively small and professional compared with the stock market, so that the underlying assets are mostly stapled commodities related to the industry and the agriculture, without close connection with the life of average people. Therefore, there're only a few professional media keeping on reporting about futures. A possible reason for MVI rise is significant fluctuations in the futures market that make the whole media circle report about "fluctuations in the futures market to cause risks" but not that MVI rise leads to the increase of absolute return in the futures market. In addition, MVI indicates the relative number of media reports about these contents, but that doesn't necessarily mean the quantity of information effectively received by investors; while SVI is a relative quantity of related contents that investors proactively search for. Generally, such search results will be acquired by investors so that SVI is more exact than MVI. The difference may also be the reason for the unmarked result of MVI.

Overall, using Internet Media Attention index has no obvious impact on futures return and absolute return value. Therefore, in later models, relevant variables of MVI shall no longer be used as control variables.

Table 4 The Influence of MVI on futures absolute return

	$FR_{f,t}$	$FR_{f,t+1}$
SVI_t	0.192*	0.322**
MVI_t	0.107	-0.039
$FR_{s,t}$	0.169**	0.012
$FR_{a,t}$	0.038	00.110**
$FR_{f,t}$	-	0.233**
$FR_{f,t-1}$	0.204**	0.005
$FR_{f,t-2}$	0.012	0.045
$FR_{f,t-3}$	0.037	0.191**
$FR_{f,t-4}$	0.186**	-0.036
$FR_{f,t-5}$	-0.050	-
R^2	0.522**	0.499**

* and ** represent significance at the 5% and 1% levels respectively.

4.2 Impact of search volumes from different terminals on futures price

In this section, we shall subdivide search volumes to make two groups: PC-based search volumes and mobile-based search volumes, in order to study the heterogeneity of search volumes from different terminals. After testing the models in Formula (9) and Formula (10), the result is shown in Table 5. The second column of table 5 shows the impact of variables on futures price for Day t. It can be seen from table 5 that the search volumes from mobile terminal are evident at the 0.05 level while the search volumes from PC-based terminal are non-significant. That means mobile-based search volumes have more significant impact on futures price for Day t compared with PC-based search volumes. However, we get an opposite result in the third column of table 5. PC-based search volumes are evident at the 0.05 level while mobile terminal search volumes are

non-significant for the futures price for Day t+1. The result shows that mobile-based search volumes and PC-based search volumes respectively exert an obvious impact on the absolute return value for futures of Day t and Day t+1. The result firstly indicates that the impact of search volumes from different terminals on asset price features heterogeneity. Investors using different terminals, due to different terminal characteristics, will produce different results of impact from their searching behaviors. Investors using the mobile terminal for search are usually faster in response and tend to make decisions fast after rapid collection of information, thus affecting asset price. By contrast, PC-based searches are mostly reflected in the impact on price change of the next trading day. The reason for the result may be that investors have more difficulties in processing the information obtained via the mobile terminal. Generally, the mobile has a screen smaller than PC, showing less information on a single page; many web pages are not well adapted to the mobile terminal so that the readability of information is low and text entry is of low efficiency. Such factors may make it hard for investors to obtain complete and correct information when searching the information on the mobile so that investors cannot easily make judgments as to the nature of information. Also, those who search on the mobile favor timeliness of information so that they will easily make instant decisions; while those who search on PC can make full and correct interpretation of the information so that the impact on the return can last till the next day. Secondly, the fact that mobile search volumes can have an evident impact on the scope of return on assets shows that mobile search volumes will help shape consistent judgment as to the direction of asset price change for the day, and more attention helps enlarge the scope of change.

Table 5 The Influence of different search terminals on futures absolute return

	$FR_{f,t}$	$FR_{f,t+1}$
$SVI_{pc,t}$	0.123	0.164*
$SVI_{m,t}$	0.174*	0.131
$FR_{s,t}$	0.170**	0.013
$FR_{a,t}$	0.036	0.111**
$FR_{f,t}$	-	0.232**
$FR_{f,t-1}$	0.206**	0.005
$FR_{f,t-2}$	0.011	0.045
$FR_{f,t-3}$	0.036	0.191**
$FR_{f,t-4}$	0.186**	-0.036
$FR_{f,t-5}$	-0.050	-
R^2	0.513**	0.492**

* and ** represent significance at the 5% and 1% levels respectively.

4.3 Impact of search volumes from different terminals on noise trading

The results of testing Formula (11) and Formula (12) show in Table 6. The second column of table 6 demonstrates the impact of PC-based search volumes and mobile-based search volumes on the turnover rate of Day t. The result shows that with other variables controlled, mobile search volumes obviously impact the turnover rate at the 0.01 level while PC search volumes are non-significant. The result is consistent with our guess, showing that mobile search volumes have a more obvious impact on the turnover rate. The third column of table 6 shows the impact of PC

search volumes and mobile search volumes on the turnover rate for Day t+1. As for the forecast of the turnover rate for the next day, we can see that the mobile search volumes have a similarly marked effect on the turnover rate of the next day, but the search volumes from PC terminal have no obvious effect on the turnover rate of the next day. Meanwhile, the return range of the foreign futures markets amid the control variables replaces the return range of futures in the Chinese market to make a factor that clearly impacts the turnover rate for Day t+1. The result echoes with the situation above mentioned that foreign futures markets will be more likely to impact the next trading day due to the trading time difference.

It can be seen from the result of Table 6 that with other factors controlled, PC-based search volumes have no obvious impact on futures turnover rate. However, mobile-based search volumes have obvious impacts on the turnover rates of Day t and Day t+1. The results indicates that those trading which collect information by mobile searching show clear characteristics of noise trading, while traders based on PC-based searching don't. Thus, investors by PC-based searching have a better ability to explain information, so that they'll be more likely to make correct judgments as to the change of asset price. This somehow confirms that PC-based search volumes will exert an impact on the return on assets lasting till the next trading day.

Table 6 The Influence of SVI from different search terminals on futures turnover rate

	TU_t	TU_{t+1}
$SVI_{pc,t}$	0.041	0.021
$SVI_{m,t}$	0.081**	0.083**
$FR_{s,t}$	0.028	0.044
$FR_{a,t}$	-0.027	0.059**
$FR_{f,t}$	0.195**	-0.010
TU_t	-	0.416**
TU_{t-1}	0.372**	0.194**
TU_{t-2}	0.214**	0.055
TU_{t-3}	0.050	0.072
TU_{t-4}	0.076	0.086*
TU_{t-5}	0.097**	-
R^2	0.741**	0.7**

* and ** represent significance at the 5% and 1% levels respectively.

5 Summary and concluding remarks

Following the theory of investor attention, the paper verifies how the search volumes index impact on the futures market, explains and differentiates the trading behavior differences between investors collect information by PC-based search volume index and mobile-based search volume index.

Unlike the stock market, there's no asymmetric impact of investor attention on the price in the futures market. The hypothesis that individual investors are net buyers of the stocks that attract their attention cannot be established in the futures market. In this market, investor attention doesn't have an obvious impact on futures return, but it does clearly impact the scope of futures price change instead of the direction of price change. Moreover, we don't find evidence that media

news index have a significant impact on future return and scope of future price change.

The impacts of investor attention from different terminals on the scope of futures price change feature heterogeneity. Investor attention from PC terminal obviously affects the scope of futures price change of the next day but has no effect on the scope of price change on that day. By contrast, mobile-based investor attention clearly impacts the scope of futures price change of that day but has no effect on the scope of price change for the next day. That means when SVI is used as a proxy variable for investor attention, the investor tend to make a hotheaded trading after they collect information who search by mobile terminal, and the investor tends to comprehensive use information instead of hasty trading who searing by PC terminal.

Investor attention from different search terminals shows different characteristics of speculating trading. For the futures market of the day and the next day, the characteristics of speculating trading are evident on investors using mobile search. However, the PC-based search volume index have not significant impact on turnover rate. This result also indicates the investor make more rational trading who search by PC than who search by mobile terminal.

From the above, we can find the impact of mobile-based SVI on price can't extend to next trading day, and the impact of mobile-based SVI on turnover rate can extend to next trading day. It means the trading that decides by mobile-based SVI have characteristics of noise trading. And the trading that decides by PC-based SVI is more rational due to it can't lead to speculate trading but have effect on price change at next day. The cause can be interpreted that investors relying on mobile search have a weaker ability incorrectly processing the information than those based on PC search so that investors using mobile search will give rise to more noise trading, while PC-based investors will be more likely to make correct judgments as to asset price, thereby impacting the trading price of the next day.

Overall, our conclusions have two points as follow:

1. The future market does not have the asymmetry which exists on stock market, the search volume index only impacts on the scale of future price change instead of direction.
2. There is heterogeneity that search volume index effect on future market between PC-based and mobile-based. For next trading day, PC-based SVI influence the price and mobile-based SVI looks like noise trading.

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