Study on the Dual Tender Offer Information Leakage：
Based on Residual Error Ratio Model

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Abstract： Information leakage, generated inside trading and stock price manipulation of listed corporations, has highlighted in the academic research, and has also been terribly serious on basis of most conclusions. Therefore, new academics significance will be back to the study on finding some more effective means to solve these problems. While "dual tender offer" is a characteristic feature of Chinese capital market as the transition of market-oriented mergers and acquisitions, it has very important significance for the study of "dual tender offer" information leakage. From the traditional perspective of stock price abnormal fluctuation, this paper adopts a new theoretical approach −"residual error ratio model" to test the stock price performances before the first annoucement of "dual tender offer" information and indicate the result that the method is convenient and practical, and can also make up for the limitation that "temporary suspension system" discovers abnormal fluctuation of share price.

Keywords: Information Leakage, Stock Price Abnormal Fluctuation, Residual Error Ratio Model, Dual Tender Offer

1 Foreign and Domestic Study on Information Leakage

Numerous studies have demonstrated that stock price of listed companies frequently appears abnormal fluctuation before important events announced which one of explanations is information leakage. However at present, studies directly on information leakage is quite few, and most of them are carried out from the perspective of two market behaviors---"inside trading" and "selective disclosure". The later, less studied at home and abroad, is very similar to inside trading, so selective disclosure is thought as prearrangement. Given that receiver and disseminator have engaged in trading based on the inside information, inside trading will be confirmed. Therefore this paper emphasizes on inside trading which is ultimate behavior of selective disclosure.

Inside trading is fallen to studying earlier at abroad, as a rule, the abnormity of stock price and exchange volume before information disclosure about M&A(Merger and Acquisitions) is thought as the proof of inside trading. all of the conclusions coming from Keown（1981）[1], Sehwert(1996)[2] and Bris(2000)[3] indicate that the abnormal return before information disclosure account for much more proportion of gross income in M&A, as illuminates that information leakage and inside trading is extremely grave. The domestic studies on inside trading are in accordance with the overseas demonstration research methods and judgement standards, such as Zhu hongmei(2003)[4], Tian manwen(2007)[5] and so on, which identically consider that information leakage and inside trading,

in particular, is grave on securities market in China. Still, because of asymmetric information, insiders may manipulate stock price and engage in inside trading by trading against their information and by adding noise to their trades based on their information advantage[6], so that supervision become more difficult .

2 Foreign and Domestic Studies on the Relationship between Information and Stock Price Fluctuation

There are quite a few academic fruit on this field and the result illustrates that scholars are apt to explain stock price fluctuation from microcosmic angle. Among these, a famous market microstructure theory declears that price fluctuation comes from new information arriving in market successively and absorbed into market price. Once some new information, advantage or disadvantage one, reaches securities market, exchange will come to life and trading volume will augment rapidly, meanwhile, stock price will fluctuate more impetuously. For example, Clark(1973)[7] believes that price fluctuation mostly originates from the information bundle reaching market. Henceforth, many scholars, such as Pan yue, Wu shinong(2004)[8], Xiao shufang, Li yang(2004) [9], found the notable correlation between stock price fluctuation and new information bundle.

One starting point of this paper will set about studying on the apparent phenomena, which is whether stock price of aim companies as the samples abnormally fluctuate or not in event period basing on above study fruit. then judge whether listed company happens to leak information about M&A combining with its information disclosure.

3 Literature Review of Main Research Methods on Stock Price Abnormal Fluctuation

3.1 Main Research Methods

Based on the relative foreign and domestic literature review, this paper finds that scholars studied the reason of stock price fluctuation and the influence of interior and exterior factors on fluctuation by all means and from all angles which sets up the theoretic foundation in this field. The event study method as mainsream of studying stock price reaction to particular affair was brought forward first by Dolley in 1933, Fama, Fisher, Jensen & Roll(1969) and Ball & Brown(1968) turned it into system info, and then event study method became a method the most frequently used for study on stock price reaction to significant event.

After that, Dodd and Ruback[10]（1977）, Asquith（1983）[11], Bruner (2002) [12] etc, applied this method firstly to the research on M&A and made an outstanding contribution.

Since Engel（1982）, Bollerslev（1986）and Nelson(1990) did research on stock price fluctuation by dint of ARCH、GARCH and EGARCH model in turn and then set up GARCH series model, many scholars such as Craig A D.（2001）[13], CHIN WEN CHEONG（2006）[14]、Elza Jurun（2007）[15], and so on, began to use GARCH series model to study stock price abnormal fluctuation recently too.

Because of later leadoff, domestic scholars followed foreign mature method and most of them used event study method or GARCH series models to judge abnormal fluctuation from all angles. This paper will refer to event study method as demonstration.

The other one valuable research fruit, share price reaction level analysis method invented by Beaver（1968）[16], via the formula $PR = E_{it}^2 / Variance(E_{it})$,

analysed the relation between abnormal return rate E_{it} and its fluctuation rate Variance(E_{it}) in the period before and after the day when payoff informaiton of listed corporations is disclosed (t=0), and thereby, got PR's alteration state and rule, and then judged the relationship between payoff informaiton and stock price fluctuation.

3.2 Comment on Research Methods

Scholars' researches supply the research point and method of this paper with better thought. However through the literature review, this paper finds that the superiority of GARCH series models is its' forecast function despite that it can imitate preferably fluctuation charactor of stock price, moreover, except for eliminating market influence before calculating abnormal return rate, event study method doesn't eliminate the influence of industry index fluctuation the stock belonging to on abnormal return rate. Consequently, we cann't get a precise calculation result of abnormal return rate. The other hand, former research didn't bring forward idiographic quantity index to ascertain abnormity, as results in that event study method is not efficient to judge information leakage but to judge no information leakage.

Furthermore, most conclusions indicate a terribly serious fact based on information leakage, inside trading and stock price manipulation. Hence, new academic significance will be back to the study on finding some more effective means to judge these problems, so this paper attempts to use a new method "residual error ratio model" to refine the research.

4 Empirical Analysis on Residual Error Ratio Model

In fact, residual error ratio model is a kind of creative model combining event study method with share price reaction level analysis method in this paper. Its first calculation step is the same to Event study method, that is, which normal return rate must be calculated firstly on basis of a supposition that no event happens in the research time. However, two research windows set in an estimation are usually necessary to calculate the normal return rate: one is event period, which includes some exchange dates in front and behind of the date significant event announced, the other is clean period, in which there are no any significant event.

The second calculation step, that is the formula (1), is to set up the residual error ratio model as follow:

Table 1. Tender Offer Cases of Listed Corporations

Announcement Date on M&A	Name of aim stock	Proportion of devolvement	Industry of aim listed corporation
20030409	Nangang stock	29.05%	Metal
20030414	Chengshang group	65.38%	Wholesale&retail
20030618	Donghua industry	55%	Real estate
20040112	Meiluo pharmacy	36.61%	Medicament industry
20040922	Jinjing scie&tech	61.95%	Manufacture
20041220	Hayao stock	65.24%	Medicament industry
20050712	Anyuan stock	61.39%	Machine industry
20051026	Xugong scie&tech	57%	Machine industry
20051206	Wuhu harbor	39.19%	Transportation
20051208	Shenzhen huaqiang	47.50%	Synthesis industry

Sample origin：《the comment on chinese M&A in 2006》 Machine industry publishing company ,No1 vol in 2006

4.1 Configuration of Sample

Despite that all the tender offer cases are not real tender offer in our country but dual tender offer in which circulating share and not circulating share are made disparate price, as an important mode of M&A, the tender offer must be one of mainstream modes of listed corporation M&A in the period of all-circulation capital market. Meanwhile, because of the greater impingement brought by the dual tender offer and the longer appointment term set by securities law, the semimarket-oriented tender offer in our country is easier to bring inside trading or stock price manipulation caused by information leakage than administrative agreement M&A, therefore the research to judge information leakage by those sample of the tender offer has very important significance.

With a view to oneness of the samples, this paper gets 10 samples for empirical test of residual error ratio model (table 1) , which are chosen from all the dual tender offer cases in the light of listed corporation control right devolved during the year of 2003 to 2005 when there is no new or amended supervision measure to be implemented.

4.2 Window Design

This paper is carried out in the form of "clean period" window and "event period" window too, and holds that the calculation of "normal return rate" is more vulnerable to occasional factors if "clean period" is too short, and at the same time, the deviation of parameters estimate value of "normal return rate" within the "event period" is too large; If "clean period" is too long, although that is preferable in theory, which has a heavy work in calculation. In addition, too short "event period" cannot reflect too early information leakage problem of tender offer, and too long one may lead to share price change caused by other significant

events of listed companies and then the wrong conclusion or complication of reason analysis.

So the window period in this paper is set to [-120,0）, 120 trading days in total, in which: [-120, -31], 90 trading days altogether is defined as the "clean period" and [-30,0), 30 trading days altogether is defined as the "event period"; the first information disclosure day of tender offer is defined as t=0 (this paper focuses on the problem of information leaked or used before t=0, so t = 0 is not included in "event period"); as long as the "residual error ratio" of stock return rate meets or exceeds the standards set by this paper during the 30 trading days[1], this paper believes that the listed company's share price has appeared abnormal fluctuations, and is reasonablely demanded to be suspended and make explanation.

4.3 Model Built

According to windows design, during "clean period", through the regression of equation:

$$R_t = a + b\ r_M + c\ r_H + \varepsilon_t$$

r_M is daily return rate of the market;

r_H is daily return rate of the industry of the share,

ε_t is residual error of daily return rate.

This paper has modified the market model, and eliminated the influence of the industry trend over individual share's daily return besides the market trend on the basis of the former model:

$$R_g = a + b\ r_M + \varepsilon_t$$

i.e. adding r_H into the equation. Parameter estimate $\hat{a}, \hat{b}, \hat{c}$ and square sum of residual error $\Sigma\varepsilon_t^2$ can be calculated by linear-regression.

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[1] Note:30 trading days does not include suspending day of individual share, and if there is suspending day, the event period extend forward.

Then standard error estimate of "clean period" can be calculated from square sum of residual error:

$$\hat{\sigma}_g = s_g = \sum_{t=-120}^{-31} \varepsilon_t^2 / (L-3)$$

Here, L=90, i.e. is number of days of the "clean period". Then it calculates "residual error ratio" of daily return rate during "event period" based on estimate of standard error during "event period", and the calculation formula is:

$$v_{gt} = (R_{gt} - \hat{R}_{gt})/s_g = (R_{gt} - \hat{a} - \hat{b}r_{gM} - \hat{c}r_{gH})/s_g = \varepsilon_{gt}/s_g \quad (1)$$

v_{gt} is "residual error ratio", R_{gt} is actual daily return rate of share price during "event period" ($R_{gt} = \ln P_t - \ln P_{t-1}$, P_t is closing price of the tth trading day[2]), r_{gM} and r_{gH} are daily return rate of the market and the industry of individual shares during event period respectively. $r_{gM} = \ln M_t - \ln M_{t-1}$, of which M_t is the market index of the tth day, and $r_{gH} = \ln H_t - \ln H_{t-1}$, of which H_t is industry index of the tth day which each sample belongs to.

This paper determines whether the stock price fluctuation is abnormal on the basis of the frenquency of absolute value of "residual error ratio" during "event period" calculated $|v_{st}| > 2.33$. The explanation is as followed:

According to the law of great number, alarm threshold determined by probability method is getting closer to the actual situation, with the increase of the sample data. Because residual error of daily return obeys normal distribution, i.e. $\varepsilon_t \sim N(0, \sigma^2)$, and $v_{gt} = \varepsilon_{gt}/s_g$, so "residual error ratio" of daily return rate obeys standard normal distribution, i.e. $v_t \sim N(0,1)$. The probability of the absolute value of "residual error ratio" is greater than the given positive number c can be expressed as $P(|v_t| > c) = \alpha$. When the total

number of "residual error ratio" is N, the mean value of the number of which absolute value is greater than c is $N\alpha$, of which α is the probability, variance is $N\alpha(1-\alpha)$, and the number K of that the absolute value of "residual error ratio" is greater than c obeys binomial distribution, parameters of which are N, α. Therefore, the probability of K greater than or equal to b can be expressed as:

$$P(K \geq b) = 1 - P(K < b) = 1 - \Phi[(b - N\alpha)/\sqrt{N(1-\alpha)\alpha}]$$

If setting α=0.02, i.e. $P(|v_t| > c) = 0.02$, we can know c=2.33, i.e. $P(|v_t| > 2.33) = 0.02$ according to standard normal distribution list. So it can be considered as small probability event that "residual error ratio" $|v_t| > 2.33$.

When the total number of "residual error ratio" N=30, the probability of which the number of $|v_t| > 2.33$ K is greater than or equal to 2 is (α =0.02, b=2):

$$P(K \geq 2) = 1 - \Phi[(2 - 30*0.02)/\sqrt{30*0.02*(1-0.02)}] \approx 0.03$$

That is to say: when N=30, the probability of which the number of that the above small probability event happens reaches or exceeds 2 is 3%, which is also a small probability event. If the event does happen during "event period", we reasonably believe return rate of share price during "event period" is abnormal, that is to say the share price appears abnormal flutuation. Therefore, on the basis of this, we can track down whether there is inside trading or stock price manipulation, etc. caused by information leakage.

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[2] Note: the 10 samples in this paper exist ex-warrant and ex-dividend during the study window [-120 , 0), which all are dealt with restoration of rights.

Table 2. Target Judgement on Abnormal Fluctuation in 30 Trading Days before t=0

Stock Name	The Number of $|v_t| > 2.33$	$K \geq 2$（Yes or No）	Conclusion（Normal or Abnormal Fluctuation in Event Period）
Nangang Share	1	No	Normal
Chengshang Group	0	No	Normal
Donghua Industry	5	Yes	Abnormal
Meiluo Pharmacy	2	Yes	Abnormal
Jinjing Scie&tech	0	No	Normal
Hayao Share	3	Yes	Abnormal
Anyuan Share	0	No	Normal
Jinjing Scie&tech	3	Yes	Abnormal
Wuhu Harbor	0	No	Normal
Shenzhen Huaqiang	0	No	Normal

Note：all the stock price, industry index and market index from the Big Wisdom stock software；

all the target of $|v_t| > 2.33$ from calculation result of this paper.

4.4 Empirical Conclusion of Residual Error Ratio Model

Through the method mentioned above and the reality of sample in this paper, we can get the result below.

From the table above, during "event period", "residual error ratioes" of Donghua Industry, Meiluo Pharmacy, Hayao Share and Xugong Scie&tech among 10 samples reach or exceed the standard set in this paper. In order to test the validity of residual error ratio model for judging stock price abnormal fluctuation and illuminate it's particular application, this paper will make an elaborate analysis based not on all the samples but on Xugong Scie&tech exceeding the standard set and Shenzhen Huaqiang not reaching the standard set.

From Fig.1, we can know that "residual error ratioes" of 000062 Shenzhen Huaqiang as an aim

corporation in M&A mostly distribute between -0.5 and 0.5 during "event period" [-30 , -1], none of them is $|v_t| > 1$, so we consider that those share price does not appear abnormal fluctuation during the 30 trading days before the first disclosure. Therefore, the tender offer information of aim corporation Shenzhen Huaqiang can be considered quite confidential. However, 000425 Xugong Scie&tech appears 3 times situation of $|v_t| > 2.33$. during "event period" [-30 , -1], which exceeds the set value twice, Fig.2, so we can consider 000425 appears abnormal fluctuation, and then it is reasonable for the supervisor to suspend temporarily 000425 before the first information announcement of the dual tender offer, and demand Xugong Scie&tech and their interested parties make explanation to abnormal fluctuation of share price.
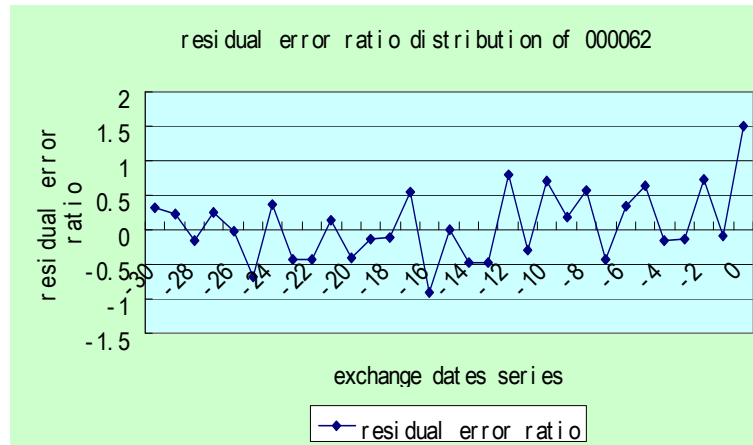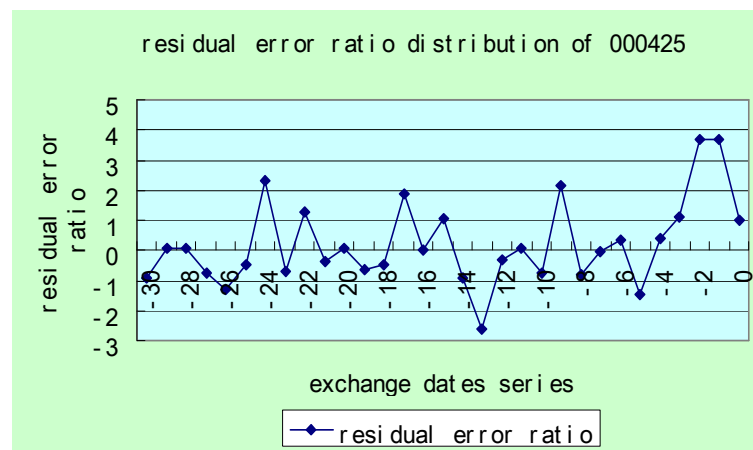
Fig. 1 residual error ratioes

Fig. 2 residual error ratioes

Table 3. Residual Error Ratio going beyond Standard set of 000425 in Event Period

Date Series (t=)	Trading Day	Raising Extent of Stock-Price	Trade-Volume Mutiple of Former Day	Abnormal Returns	Residual Ratio	Announcement of 000425
-13	20050927	-10.%	2.20	-2.9%	-2.61	No announcement
-2	20051019	9.9%	6.56	4.1%	3.69	No announcement
-1	20051020	10.1%	1.36	4.1%	3.71	No announcement

Data source:the Big Wisdom Software, sina finance--announcement and trading market of 000425, and calculation result of this paper.

In order to find the reason of 000425 stock price abnormal fluctuation, this paper inspects all formal announcement of 000425 attentively, and then discovers that 000425 hasn't any annoucement on the 3 trading days t=-13,-2,and -1 when share price has abnormal fluctuation, while the Big Wisdom shows that the transaction volume of that 3 trading days is quite huge compared with the volume in

former days, and the abnormal returns AR of the 3 trading days is also quite big (table 3). Therefore, it is reasonable for the supervisors and investors to question that Xugong Scie&tech and its interested parties have leaked "tender offer information" beforehand, or have engaged in inside trading and manipulate share price, etc. through subject matter of the tender offer.

However, in sight of the Great Wisdom market, we find all the three abnormal fluctuations are easily detectable because of two down limits and one raising limit, we call them apparently abnormal, which are easy to catch supervisors' and investors' attention (table 3).

After all, that is a coincidence, the fact is that the value of residual error ratio has no connection to raising limit or down limit. This contingency can be illuminated by such 4 parameters in table 4 as Raising Extent of Stock-Price, Trade-Volume Mutiple, Abnormal Returns, and Residual Ratio. Therefore, the "temporary suspension system" [3] related to raising or falling limit cannot find the "recessive abnormality" of the 10 trading days, and it's difficult for the public investors to find "recessive abnormality" from the stocks trend which has never raising or falling limit. So we can say that this paper use indicator system "residual error ratio model" design to make up the deficiency of the "temporary suspension system" related to raising or falling limit. The other conclusion of this paper is that the combination of the 4 indexes and announcement of listed corporation can perfectly judge abnormal fluctuation of share price and information leakage of listed corporation significant events.

5 Conclusion

This paper gets that previous research program is far from convenience and promptitude to discover abnormal fluctuation of stock price through the

organizing and summarizing of main research findings of information leakage and stock price fluctuation in foreign and domestic point of view. Therefore this paper applies residual error ratio model to determine information leakage of granted dual tender offer, the result of which shows that the method is convenient and practical, and can make up for the deficiency that "temporary suspension system" discovers abnormal fluctuation of share price. Besides, provided that the combined analysis of residual ratio, raising extent of stock-price, trade-volume, abnormal returns and announcement of listed corporation would be more perfect and efficient .

It's expected that the finding of this paper can provide supervisors and investors with proposal worthy of reference to resolve the difficulties of distinguishing the information leakage of listed companies' important event, inside trading or stock price manipulation through significant information.

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[3] i.e. system of issuing announcement of temporary suspension of continuous 3 raising limits or 3 falling limits

Table 4.Variable of Abnormal Trading Days of 3 Abnormal Samples

Stock Names	Trading Day(t=)	Abnormal Date	Raising Extent of Stock-Price	Trade-Volume Mutiple of Former Day	Abnormal Returns	Residual Ratio
Meiluo Pharmacy	-3	20031208	-3.2%	0.63	-0.91%	-2.53
	-1	20040105	3.1%	1.69	3.29%	6.11
Hayao Share	-20	20041122	9.5%	8.04	3.82%	4.79
	-18	20041124	-6.3%	0.54	-2.36%	-2.97
	-2	20041216	4.7%	1.24	2.31%	2.89
Donghua Industry	-27	20030512	-7.9%	1.99	-3.22%	-7.10
	-26	20030513	0.5%	0.86	1.43%	3.16
	-15	20030528	1.3%	2.49	1.35%	2.99
	-5	20030611	4.6%	3.30	1.19%	2.65
	-1	20030617	3.0%	0.60	1.39%	3.07

Data source: the same as Table 3

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