

# HAS CHINA'S THE NON-TRADABLE SHARES IMPROVED LISTED COMPANIES' PERFORMANCE? A DEA EVALUATION OF CHINA'S LISTED COMPANIES

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## **Abstract**

Non-tradable shares reform solves the “binary equity structure” problem existing for a long period in China. At the same, the reform brings behavior changes of different sort of shareholders. We analyze the behavior of state-owned shareholders, corporate shareholders, public shareholders and foreign capital investors in corporation governance before and after non-tradable shares reform. To evaluate the efficiency these changes, a set of method based on DEA model is established.

**Key words:** Non-tradable shares reform, DEA, Malmquist Index  
Shareholders' Governance Efficiency, China

## **Introduction**

Compared with oversea mature capital markets, capital market in China has its own characteristics. In terms of background, it is a new systematic arrangement, bushed by the government, in the course of economy transition. Such a special background results in the special equity structure of listed companies in China, i.e. “binary equity structure”. The structure performs as the different negotiability between not-tradable shares, including state-owned stock, corporate stock, and tradable public stock in stock market. Furthermore, the corporate stock can be divided into state-owned corporate stock, foreign capital owned corporate stock, inner-capital owned corporate stock and so on.

“Binary equity structure” brings about the phenomena in China of the co-existence of state-owned stock and corporate stock as non-circulation stock and public stock as circulation stock, with the former overwhelming, and the phenomena that same stock of different prices and various equity rights. Estrin and Perotin (1991) argue that, even if the government is not corrupt, the firms under the control of the government shareholder cannot concentrate on profit maximization, because the state has political as well as economic objectives while governance will be weaker. Thanks to the phenomena, there are some differences between non-circulation shareholders and circulation

shareholders in terms of obligations, rights, benefits, target function and so on. Lacking of mutual interest ground, the corporate share price can hardly incent or restrict the major shareholders and management staff. Therefore, problems such as inefficient regulation and negative affects on the corporate operating emerge.

On May 8th, 2005, China Securities Regulation Commission issued “Notice on the pilot reform of non-tradable shares of listed corporations”, which symbolized the initiation of China non-tradable shares reform. The non-tradable shares reform is a process of eliminating systematic differences of stock transfers in A-share market by the mechanism of negotiating and balancing the discrepancy between non-circulation shareholders and circulation shareholders. The reform is closely related to the improvement of corporate governance. As what China Securities Regulation Commission said, “the non-tradable shares reform is to optimize the governance structure of the company, solidify the mutual interest ground of all shareholders, promote the listed companies to use various innovative financial tools to improve the capital operation efficiency, optimize the capital structure, bring in better investment returns.” It is clear that the reform is a systematic one that aiming at improving corporate governance and operation efficiency and optimizing capital market.

The article firstly analyzes the governance problem of the listed

companies in the non-tradable shares era. They are the consequence of equity structure and circulation mechanism, absence of owner, serious “insider control” phenomenon, inefficient surveillance commission, separation of shareholders’ interest, inadequate incentive mechanism for the management and negative impact on the corporate performance.

Based on the analysis, we contrast the behaviors in the corporate governance of different shareholders before and after the non-tradable shares reform. Shleifer and Vishny (1997) conclude that “Corporate governance deals with the ways in which suppliers of finance to corporations assure themselves of getting a return on their investment.” We think that after the reform, the interests of non-circulation shareholders and circulation shareholders tend to be unified and the channel of getting return for major shareholders is changed. Furthermore, the equity structure is multiform; more corporate stock will take place in the state-owned stock. The governance power of corporate stock and foreign shares is strengthened, while that of the state-owned and public stock will not change greatly.

Finally, according to the financial index representivity of the listed companies of China, we establish the DEA model to comment the holders’ performance in the corporate governance.

Data Envelopment Analysis approach (hereinafter referred to as “DEA”) is a new area and method in the cross-discipline research of

operational research, management science and mathematical economics, a non-parameter statistical way of commenting the technical efficiency of decision-making unit of more input and more output in the same model on the basis of relative efficiency concept (Boussofiane A , Dyson R G, Thanassoulis E.1991, Xunan, Huang, 1993) . DEA has established itself as a popular analytical research instrument and practical decision-support tool, capable of dealing with a wide variety of different problems. Many empirical researchers (Färe et al 1985, 1994, Jan-Egbert Sturm and Barry Williams, 2003, Wen-Chih Chen and Leon F. McGinnis, 2005) believe that DEA is utilized in the evaluation process. It can be an effective non financial indicator to measure corporate performance and bench marking.

## **Problem Analysis of Listed Company Governance in the Non-tradable Shares Era**

In the non-tradable shares era, the governance of listed company has following problems:

### **1. Unreasonable Share Framework and Floating Mechanisms**

The Unreasonableness of the listed company share structure has two handles: (1) excessive kinds of the shares. Seen from the angle of proprietary subject, there are three kinds of shares issued by the listed

company: state-owned shares, corporate shares, and public shares. There is no negotiability for state-owned share and corporate shares, that is to say, these two kinds of shares can not be trade freely as public shares do on secondary market. The general shares as tradable stock can be further divided into share A, share B, share H, and share N. (2)Exorbitant proportion of non-tradable share, state-owned shares is “too big”. According to statistics, by the end of the year 2004, the general capital of the A share stock market reached to 712 billion, in which there are 454.3 billion non-tradable shares, that is 64 percent of the general capital, state-owned shares occupies 74 percent of the non-tradable shares. The tradable stock is 257.7 billion, which only occupies 36 percent of the general capital.

In addition, the floating of interest capital has two prices: protocol transfer between non-tradable shares, dealing price in stock market. The differences that exist in circulation of shares and transferential order dissever the relativity of different shares in a company factitiously, twist the mechanisms of capital market-set prices, restrict the function of resource allocation.

## **2. Omission of Proprietor**

Unreasonable shares structure and floating mechanisms result in the situation that the state-owned shareholders control the corporation

absolutely. In share framework, the state-owned shareholders, which have huge shares, control the board of directors and the handlers of the listed company through corporate governance framework and “equity-agency mechanism”, and then control the whole corporation. However, the state-owned shares lack a clear proprietor. Although the state-owned shares control the listed corporation absolutely through separate ownership from managerial authority, the authorized holding company and national asset company are only succedaneum of the state-owned shares, not the proprietor of the shares. This leads to the omission of proprietor.

### **3. Sever Phenomenon of “Insider Control”**

Most of the listed companies in China are listed through share-holding reforming by nationalized business. In the process of reformation, the relationships between corporations entrust and proxy are not rationalized, the problem of proprietor omission is not solved. Hence the handlers of the corporation are independent from the corporation proprietor to a certain degree, and they control the company in practice. They pursue the satisfaction and maximization of their own interests; make the proprietor controller and supervisor a mere figurehead, and then comes the “insider control” phenomenon. It is the existences of “insider control” phenomenon that make the company operator tend to short term

activities. They tend to realize the short term interests of the corporation instead of the long term interests. The operators have limited concern on the company, and even sacrifice stockholders' interest in order to pursue their own interests.

#### **4. The Function of the Supervisory Committee is not Notable**

The corporate governance system in China can be basically considered as parallel binary. The Director Board and Supervisory Committee are all produced by general meeting of shareholders, and they are responsible for the meeting. Because the members of Supervisory Committee are from the shareholders and employees, they are nominated basically by the majority stockholder. The independence of the members is influenced by many factors unavoidably. What is more, most of the supervisors are not well-equipment, and have poor professional knowledge, so they can not assume their due responsibility on the whole. But the external supervisors seldom take part in the board of the supervisors, which has no relationship with the board of directors on nomination and authorization, this situation makes the Supervisory Committee performing inefficient.

#### **5. The Separation of Stockholders' Interests**

In the non-tradable shares era, the essential feature is the separation

of different stockholders' interests, which leads to series problems such as difference in the interests function and the way of interests' realization of stockholders and gaming among them. In full-blown capital market, the mode that the majority stockholder obtains benefit should be 'strengthen the corporate governance—increase the achievements—share prices show significant advances—the stockholder obtain benefit. The behavior of the majority stockholder in the corporate governance register as the benefit of the stockholders, and so form a virtuous circle, which urge the majority stockholder pay more attention on corporate governance. However, this cyclical pattern is dissevered factitiously because of the 'binary equity structure'. And then the majority stockholder, most of whom are non-tradable shareholders, have a mode of obtains benefit as 'high financial target—premium price of refunding—the raise of net asset—the stockholders' share increases'. The association between interests of the majority stockholders and the share price changes is weak. Because of the premium that caused by the way of new share allotment or refunding, the majority stockholders gain even greater advantage. Compare with these majority stockholders', the benefit of stockholders of the tradable public shares, have close relationship with the share price. Company refunding bring bare profit. On the contrary, the interest of the tradable share stockholders is plundered by the majority stock holders through high premium price and application of corporate funds.

## **6. The Encouragement of the Management Level is not in Place**

In the non-tradable shares era, the shares held by management level of listed company is of low specific gravity. Although the management levels of a few companies hold the shares, the negotiability of the non-tradable shares is limited. The stock option is an important manifestation of the management level's long-term encouragement. Because they hold small non-tradable shares, it is difficult to realize stock option. This make the company management fail to gain effective encouragement, and the cost of proxy is escalated, the management level tend to myopia action.

## **7. The Achievement of the Company is Influenced.**

The problems analyses above directly influence the performance and achievement of the listed company. The financial affairs are not completely opened, and the publication of information is not in time. In financial affairs, there are many law cases of skullduggery, which directly result in damage of minority stock holders' interests, mostly public shareholders. In addition, because lack of proper and effective encouragement system and supervision, the operators of the company tend to get short-range profit instead of the company's long-range profit in order to improve the short-range achievement of the company. Hence

the long-term development of the company is influenced.

## **Analysis of Shareholders' Behavior in the time of Non-tradable Shares**

### **1. Analysis of State-owned Shareholders' Behavior**

State-owned stock occupies the largest part in the equity structure in the listed companies of China, and it is also the most special one. In the time of non-tradable shares, the corporate equity is highly centralized to guarantee the state's control over enterprises, resulting in the domination of state-owned stock. Meanwhile, to avoid the devaluation of state asset, the circulation of state-owned stock is restricted seriously.

However, shareholders of state-owned stock do not have complete equity right and the administrative load is too heavy. In a word, there is no definite owner of state-owned stock. Although State-owned Asset Supervision and Administration Commission of State Council has established the mechanism of state asset agency characterizing as authorized management of different ranks, the problem of ownership remains unsettled, for the agents in this mechanism is not the investor or owner in true sense.

Because of the absence of owner, holders of the dominating state-owned stock can hardly perform its responsibility in the corporate governance. The interest of state-owned stock representative is not

interlocked with the corporate governance so much, which results in the lack of impetus in the governance as well as the inefficiency governance of the shareholders. Furthermore, the high proportion of the state-owned stock and its poor circulating ability cumber the equity right diversification. This goes against the idea of letting main party of the diversified equity right take part in the corporate governance.

As regulated in the “Corporation Law”, shareholder meeting is the supreme organization, consisting of all the shareholders. In China, the non-circulating stock shareholders, especially the state-owned stock holders are in the holding position, so they have the absolute voting advantage in the shareholder meeting. Most directors are nominated by the government, so the company is possibly in the administrative interference. Directors act on the government’s opinion rather than the daily operation and the current situation of the company. It is no doubt that administrative intervention plays an important role in the macroeconomic regulation and industrial structure readjustment, but it also may lead to the split of corporate behavior and the demand of the market. So the corporate performance, value and its shareholders’ interest are affected. What’s worse, since the state-owned stock holders’ interests are not related to the share price, the short term loss resulted from such reform and regulation is unavoidably shouldered by medium or minor holders of public stock.

## **2. Analysis of Corporate Shareholders' Behavior**

Corporate shares can be divided into initiator corporate stock and public corporate stock. Since the state stock is nonnegotiable, it only can be transferred to corporate shareholders by assignment. Because of the scarcity of listed corporation resource, many enterprises get launched by purchasing state-owned shares. Such action leads to the increasing proportion of corporate stock, becoming a significant part in the share structure. According to statistics, from the end of 1992 to that of the 1998, the proportion of corporate stock in the total share increased from 18. 34% to 28.33%.

Many scholars tend to affirm the positive effect of corporate stock in the corporate governance, such as Xiaonian Xu, Yan Wang (2000), Zhidong Yu (2001). But demonstrative research conducted by Guoliu Hu and Jinggui Huang (2005) shows that the positive effect of the corporate stock proportion and the corporate governance did not gain strong support, and they think that “corporate stock may have played its supervisory role in the governance, but such function is not that tangible. The reason might be the deputization dilemma in the corporate shareholders themselves. This results in the fact that the governor of the corporate shareholders does not have strong desire to carry out efficient supervision on the managers of listed companies.”

In the time of non-tradable shares, because the main invest body was

hard to be diversified, the shareholders of state-owned stock governed inefficiently and the shareholders of public circulating stock might act “free-rider”. Therefore, outsiders expected more on the corporate shareholders' function in the governance. But we think that in terms of interest realization of corporate stock, because of the non-negotiability of the stock, the interest realization is not affected by the share price. So shareholders are not enthusiastic in taking part in the governance. Thanks to the fact that corporate shareholders have the definite main investing body and the corporate performance is closely related to their interest, corporate shareholders are more powerful than state-owned stock holders in the governance.

Furthermore, we find that the effect of “tunneling” of the major shareholder cannot be ignored. According to Yubiao Zhang (2006) empirical research of Chinese A share market including more than 1000 listed companies from 2000 to 2004, the statistic shows that the average ratio of major holders' capital in the total asset of the listed company is always higher than 5%, even to 50% in some companies. For these shareholders, the “tunneling” of corporate stock holders occupies a great part.

We think that such an action is resulted from its important role in the board as well as the lack of main body of state-owned stock holders. The inefficient supervisory system may lead to the confederacy of corporate

stock holder and management staff to maximize their own interest by using corporate capital.

### **3. Analysis of Foreign Capital Investors' Behavior**

In the article, foreign capital investor is not the company who published shares in Chinese A share market. It represents those investors who obtain listed company's shares by negotiating with government. In 2002, listed company's A share owned by Chinese government was available for foreign capital investors again after eight years forbiddance. Although A share market re-open to the foreign foundations, the restriction coming from Chinese government regulations still exist, for the government aims to select experienced institution, and improve listed companies operating through capital and governance experience entering in. The reflection of above phenomenon is that share hold by foreign foundation is limited.

Even though state-owned shares can transfer to shares holding by foreign investors, the shares are still not in circulation. Foreign shareholders can not get interests for dealing in secondary market. With these reasons, they lack aspiration to engage in corporate governance. The target, which is bringing rich experience in corporate governance and improving the performance of the company through transferring, has not being achieved.

More seriously, the transferee must participate in the competitive auction process. The auction bidding was strictly restricted to the foreign countries. Of course, the restriction has an impact on the fairness of the auction price. Transferees gained the shares in higher costs. As a result, the foreign investors are more likely to pursue their own interests, more energetically than government do, in the cost of affecting company's daily operating through SOEs or being "free-rider" in the refinancing process.

Some empirical studies, such as Xu Bing (2004), have confirmed this point: foreign shareholders did not perform a substantive role in listed company governance; on the contrary, some companies performed a decline.

Unfortunately, the companies containing foreign capital owned shares are rare not only in sample we collected, but also in the entire listed companies in the market. So we can not analyze foreign capital investor's function changing after the non-tradable shares reform empirically.

#### **4. Analysis of Public Shareholder's Behavior**

Shares held by public shareholder are floating in the secondary market. The great majority of public shareholders occupy a low proportion share of the list company. Their purpose is to obtain higher

capital gains in stock market than interest of saving. This part of public shareholders can easily lead to “free-rider” behavior in corporate governance participant.

In the ways of obtaining interest, public shareholders within the secondary market mainly focus on the short-term price changes, which are influenced by market information and can bring them capital gains. The phenomenon is not only associate with public's invest idea, but also influenced by the seldom dividends of companies. Since the short-term stock market movements do not have a strong correlation with the operating results, public shareholders have a very low level of concerning about the governance and company's long-term performance.

Game analysis present that public shareholders have limit benefits in contrast of high cost. Following payoff matrix gives a simple game analysis:

*Table1: gaming matrix*

		Public Shareholders	Supervision	Non-supervision
		Major Shareholders		
Major Shareholders	Supervision	ar(Q)-C(Q1), (1-a)r(Q)-C(Q2)	ar(Q1)- C(Q1), (1-a)r(Q1)	
	Non-supervision	ar(Q2), (1-a)r(Q2)-C(Q2)	ar(0), (1-a)r(0)	

(a: proportion of shares hold by major shareholders; Q1: the volume of supervision performed by major shareholders; Q2: the volume of supervision performed by public shareholders; C: the cost of supervision; C is a growth function of Q; Q is a function

of a)

From the payoff matrix, we can see the best option of public shareholders is non-supervision no matter which option major shareholders choose.

In addition to rational analysis, the right to choose of the public shareholders is restricted by major shareholders in reality. And the recommendations made by the public shareholders are often delayed to handle. All of these prevent the public shareholders from corporate governance.

## **The Conduct Changing of the Listed Company's Shareholders after the Non-tradable Shares Reform**

### **1. The Behavior Changing of State-owned Shareholders**

The non-tradable nature of state-owned shares has changed since the non-tradable shares reform. The listed companies compensate the tradable shareholders by paying a goodwill price and some other ways, as a result, the state-owned shares have been diluted. From statistics, we know that the non-tradable shares of the 45 listed companies, which had accomplished the first and second batches of China securities market, reduced by 10.4% after the reform. However, the disadvantage of the

state share that the proprietor omission was not reformed totally as the absence of the specific proprietor.

According to “Notice on the pilot reform of non-tradable shares of listed corporations” issued by China Securities Regulation Commission, “the non-tradable shareholders of the pilot companies should keep the promise that they won’t sell or transfer their shares at least in 12 months after the shares getting the permit. In addition, the shareholders who hold more than 5% shares should trade their shares after this 12month. The shares be sold should not beyond 5% in 12month and 10% in 24month. We can see from that, the tradability of the state shares is still limited in spite of reform of non-tradable shares.” From this regulation, we know, nowadays, the state shares only have the theoretic tradability. Furthermore, the governments, as the state-owned shareholders, are not like to profit in the secondary market as other shareholders.

We can see from the 2 points above that the state-owned shareholders’ functions in corporate governance have not been changed practically. Their functions on corporate governance are ineffective and even useless.

As the state-owned shares become tradable, the phenomena that the state-owned shares as the only big has being solved. Government should reform the shareholding structure by involving various investing entity. The structure of corporate director and supervisor board will be more

various and this change will bring about the improvement of the efficiency and level of corporate governance.

## **2. The Behavior Changing of Corporate Shareholders**

The floating of corporate shareholders is confined in short-time, but, the power of corporate shareholders on corporate governance must be strengthened.

The floating stock brings about the change of way on which the corporate shareholders achieve their interests. The price of the stock is decided by the marketing instead of negotiated. If the corporate have good achievement and perform well in market, the shareholder should pursue interests by selling their shares.

In addition, the corporate proportion will enlarge as state shareholders absorbing many-faceted investors. The corporate shareholder's share scale will be improved, as well as their power on corporate governance.

## **3. The Behavior Changing of Foreign Capital**

The property rights of corporate become clear after the reform of non-tradable share. The foreign capital investors' in burst and growing share holding will bring change to corporate governance.

The way of realizing the foreign capital investor's interests are

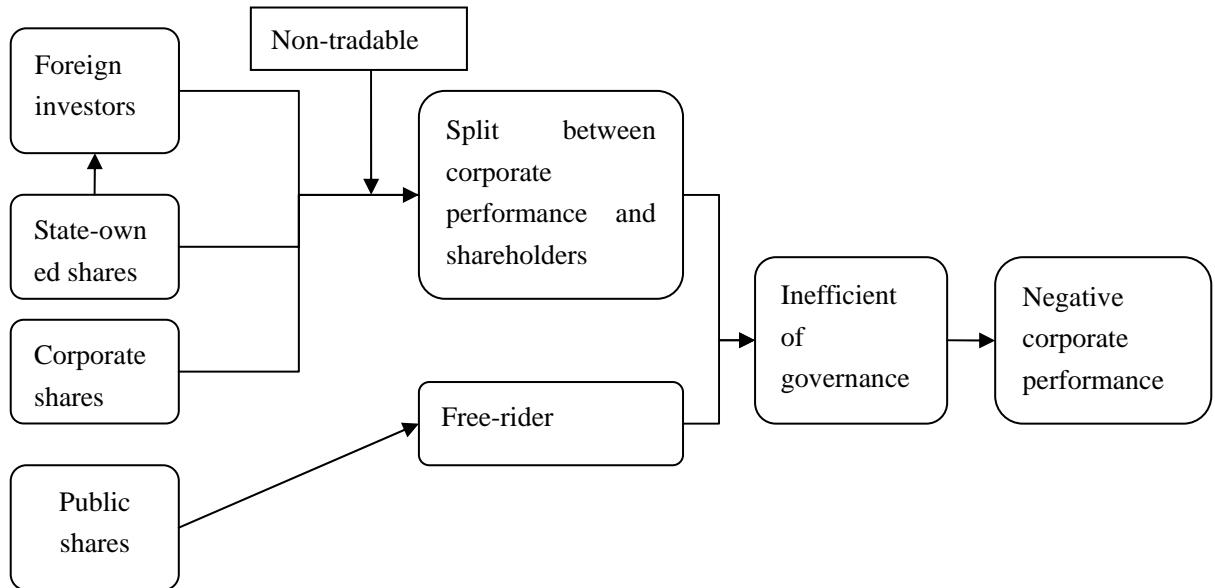
toughly associated with market reacting, the splitting between non-tradable and tradable problem has been merged. And the channel of obtain company shares is broaden, transferring price reflects more market activities. So the foreign capital owner will scale their power on corporate governance, as corporate shareholders do.

#### **4. The Action of Tradable Public Shares Stockholders**

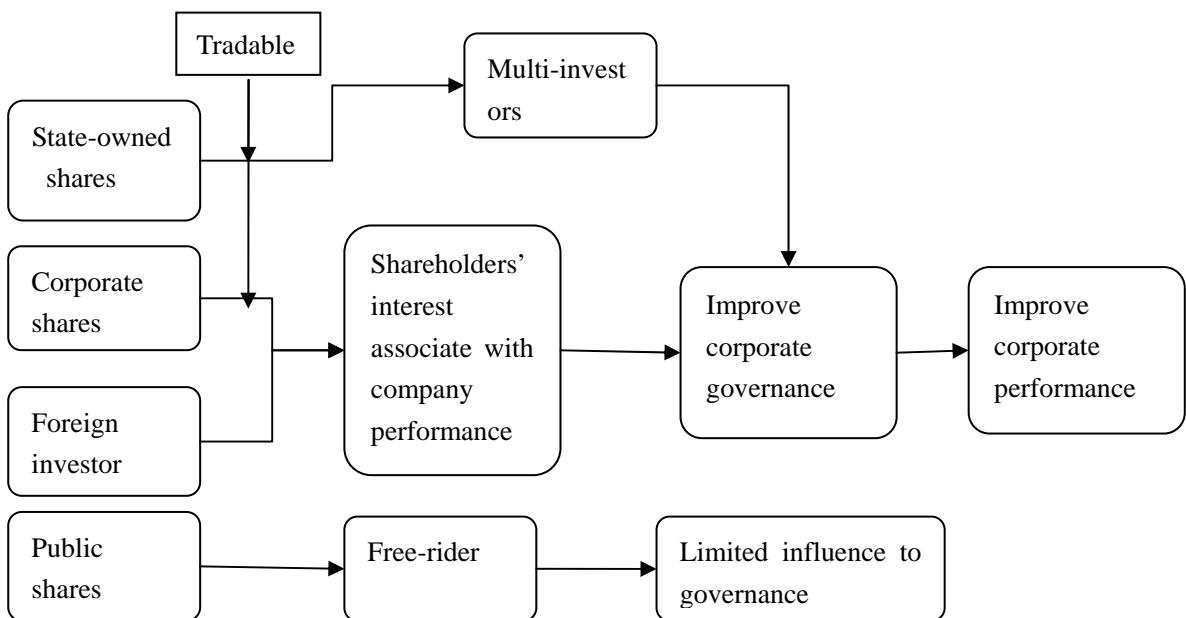
Stock holders of tradable public shares take a place of ‘passive governance’ in the corporate governance from beginning to end. The reform of non-tradable shares does not change the general public shares’ motivation of ‘hitchhike’ and their benefit analysis. Stock holders of general public shares still pay little attention to the corporate governance.

From the above analysis, we can see that the reform of non-tradable shares does bring advantages for the corporate governance of the listed company. By the way of non-tradable shares reform, the interests of primary floating shares stockholders and non-tradable stockholders are re-divided, and tend to be unanimous. The improvement of corporate governance has internal foundation. Looking from the external of the company, the reform widens the ways of improving the corporate governance, and urges the improvement of the corporate governance level.

*Diagram 1: How Do the Shareholders Influence the Corporate Governance in the Non-tradable Shares Era*



*Diagram 2: The Link between Shareholders and Corporate Governance after Non-tradable Shares Reform*



## The Basic DEA Model

Let us introduce the basic DEA model originally proposed by Charnes, Cooper and Rhodes (1978). DEA can be roughly defined as a nonparametric method of measuring the efficiency of a Decision Making Unit(DMU) with multiple inputs and /or outputs. This is achieved by constructing a single ‘virtual’ output to a single ‘virtual’ input without pre-defining a production function. In DEA, there are n Decision Making Units (DMU) to be evaluated, each DMU use different amounts of m inputs to produce s different outputs. DEA try to identify which of the n DMU can determine an envelopment surface. This envelopment surface is called empirical production function or the efficient frontier. So by comparing each DMU to the envelopment surface, the relative efficiency score are calculated. Units lie on the surface are efficient, those do not lie on the surface are inefficient.

Let us introduce the following notation:

$j = 1, 2, \dots, n$  decision making units

$r = 1, 2, \dots, t$  outputs

$i = 1, 2, \dots, m$  inputs

$y_{rj}$  amount of output r for unit j

$x_{ij}$  amount of input i for unit j

$u_r$  weight assigned to output r

The DEA efficiency measure is essentially defined as the ratio of a weighted sum of outputs to a weighted sum of inputs. Charnes, Cooper and Rhodes's idea is to define the efficiency measure by assigning to each decision making unit the most favorable weights. These optimal weights are computed by maximizing the efficiency ratio of the unit considered, provided that the efficiency ratios of all units, computed with the same weights, have an upper bound (usually set equal to 1).

Therefore, the DEA efficiency measure for the decision making unit  $j_0 \in \{1, 2, \dots, n\}$  can be found by solving the following optimization problem

$$\max \frac{\sum_{r=1}^t u_r y_{rj_0}}{\sum_{i=1}^m v_i x_{ij_0}} \quad (5.1)$$

Subject to

$$\frac{\sum_{r=1}^t u_r y_{rj}}{\sum_{i=1}^m v_i x_{ij}} \leq 1 \quad j = 1, 2, \dots, n$$

$$u_r \geq e \quad r = 1, 2, \dots, t \quad (5.2)$$

$$v_r \geq e \quad i = 1, 2, \dots, m$$

where  $e$  is a convenient small positive number formally, a non-archimedean constant that prevents the weights from vanishing (see Charnes, Cooper and Rhoades, 1979, and Charnes, Cooper, Lewin and Seiford, 1994).

The optimal objective function value (5.1) is taken as the efficiency measure assigned to unit  $j$ . Of course, to find the efficiency measure of the other decision making units we have to solve similar problems, targeted on each unit in turn.

Note that the efficiency measure have an upper bound of 1, which will be reached only by the most efficient units.

The output-oriented DEA model seeks to maximize the proportional increase in output while remaining within the production possibility set. An output-oriented efficiency measurement problem can be written as a series of  $K$  linear programming envelopment problems, with the constraints differentiating between the DEA-CCR and DEA-BCC models, as shown in Equations (1) through (5).

$$(1) \quad e\lambda' = 1 \max_{U\lambda} U$$

Subject to

$$(2) \quad U_{yk} - Y'\lambda \leq 0$$

$$(3) \quad X'\lambda - x_k \leq 0$$

$$(4) \quad \lambda \geq 0 \quad (\text{DEA-CCR})$$

$$(5) \quad e\lambda' = 1 \quad (\text{DEA-BCC})$$

The combination of Equations from (1) through (4) and (1) through (5), respectively, form the DEA-CCR and DEA-BCC models. The output-oriented measure of technical efficiency of the  $k$ -th DMU, denoted by  $TE_k$ , can be computed by equation (6).

$$(6) TE_k = 1 / U_k$$

It is important to note that input-oriented models can be formulated in a similar way. Interested readers may refer to Seiford and Thrall (1990), Ali and Seiford (1993) and Cooper, Seiford and Tone (2000) for more discussion on the above models.

The technical efficiency derived from DEA-CCR and DEA-BCC models are frequently used to obtain a measure of scale efficiency, as shown in equation (7) (Cooper, Seiford and Tone, 2000).

$$(7) SE_k = U_{CCR\_k} / U_{BCC\_k}$$

where  $SE_k$ , indicates scale efficiency and  $U_{CCR\_k}$  and  $U_{BCC\_k}$  are the estimated technical efficiency of DMU.  $k$  respectively derived from the DEA-CCR and DEA-BCC models.  $SE_k = 1$  indicates scale efficiency and  $SE_k < 1$  indicates scale inefficiency.

Scale inefficiency is due to either increasing or decreasing returns to scale which can be determined by inspecting the sum of weights, under the specification of the CCR model. If this sum is equal to one, the law of constant returns to scale prevails, whereas increasing returns to scale and decreasing returns to scale prevail when the sum is less than or

greater than one. DEA is initially used to analyze cross-sectional data, where a given DMU is compared.

DEA is initially used to analyze cross-sectional data, where a given DMU is compared with all other DMUs that produce during the same time period and where the role of time is ignored. However, this can be rather misleading since a dynamic context may give rise to seemingly excessive use of resources that are intended to produce beneficial results in future periods. As such, panel data prevail over cross-sectional data in that not only do they enable a DMU to be compared with other counterparts, but also because the movement of efficiency of particular DUM can be tracked over a period of time. In so doing, panel data are more likely to reflect the real efficiency of a DUM.

Initiated by Charnes, Clark, Cooper and Golany(1985), windows analysis is a time-dependent version of DEA. The basic idea is to regard each DMU as if it were a different DMU in each of the reporting dates. Then each DMU is not necessarily compared with the whole data set, but instead only with alternative subset of panel data. The windows analysis is based on the assumption that what was feasible in the past retains feasible forever, and that the treatment of time in windows analysis is more in the nature of an averaging over the period of time covered by the window.

The same characteristics that make DEA a useful tool can also create

problems. It is deterministic and only gives point estimates that do not provide information about uncertainty in estimation, and the estimation depends heavily upon the correctness of frontier units, measurement error can cause significant problems. Since DEA is a nonparametric technique, statistical hypothesis tests are difficult. So we use the DEAP VERSION 2.1 to calculate the DEA value.

## **Measurement of Productivity Change: Malmquist Index.**

In order to measure the change of technological productivity, Malmquist firm-specific productivity indexes were introduced by Caves, Christen, and Diewert (1982). And Fare, Grosskopf, Lindgren and Ross (1989) made use of the Geometric mean of the two output based Malmquist indexes defined by the above researchers to yield the Malmquist measure of productivity. Fare et al (1994) defines an output based Malmquist productivity change index period  $s$  (the base period) and the period  $t$  as:

$$m_o(y_s, x_s, y_t, x_t) = \left[ \frac{d_o^s(x_t, y_t)}{d_o^s(x_s, y_s)} \times \frac{d_o^t(x_s, y_s)}{d_o^{ts}(x_s, y_s)} \right]^{1/2}$$

where the notation  $d_o^s(x_t, y_t)$  represents the distance from the period  $t$  observation to the period  $s$  technology. Malmquist index represents the productivity change of the production point  $(x_t, y_t)$

$$(x_s, y_s)$$

relative to the production point

The above formula can be rewritten as:

$$m_o(y_s, x_s, y_t, x_t) = \frac{d'_o(x_t, y_t)}{d^s_o(x_s, y_s)} \left[ \frac{d^s_o(x_t, y_t)}{d'_o(x_t, y_t)} \times \frac{d^s_o(x_s, y_s)}{d'_o(x_s, y_s)} \right]^{\frac{1}{2}}$$

this decomposes the Malmquist output-oriented productivity index into the product of two terms. The first term is the ratio of two technical efficiency indexes from periods  $t$  and  $s$ , which indicates whether the technical efficiency has improved or not. The second term is a geometric mean of the shifts in the production frontier in two directions, which shows whether or not there is a technical change.

$$\text{Efficiency change} = \frac{d'_o(x_t, y_t)}{d^s_o(x_s, y_s)}$$

$$\text{Technical change} = \left[ \frac{d^s_o(x_t, y_t)}{d'_o(x_t, y_t)} \times \frac{d^s_o(x_s, y_s)}{d'_o(x_s, y_s)} \right]^{\frac{1}{2}}$$

Malmquist Productivity Index make up disadvantage of CCR and BCC, Whelock and Wilson(1999) mentioned that, static state CCR and BCC only analyze flatly contemporaneous data, so they can't discuss the variety of management efficiency of different periods. But Malmquist Productivity Index employs panel data with the concept of distance function and computes productivity Index for analyzing perpendicularly.

# **DEA Measures for Evaluation Shareholder Government**

Allowed for that the China non-tradable shares reform took places in 2005 and the annuls is usually released in the following year, so the appropriate data used in this study is from the 2004 to any year after 2006. Considering the availability of data, we choose 31 samples, which had accomplished the first and second batches of China securities market.

In empirical research, we design two steps:

1. Obtain annual static data to compute the GTE (Governance Technical Efficiency) by CCR model, and then compute the PGTE (Pure Governance Technical Efficiency). GTE/PGTE is GSE (Governance Scale Efficiency).
2. Compute the Malmquist Governance Index which reflects dynamic cross-period variety of Governance Efficiency.

The software DEAP VERSION 2.1 is employed to derive a solution to the model.

## **1. Input and Output Variables Definition**

### **1) Input Variables**

$X_1$ : NCON, the degree of the insider control.

NCON=the number of inside directors/the number of the director board members

X<sub>2</sub>: the proportion of state-owned shareholders

X<sub>3</sub>: the proportion of corporation shareholders

X<sub>4</sub>: the proportion of the public shareholders

X<sub>5</sub>: the proportion of the management shareholders

X<sub>6</sub>: the sum proportion of the top 5 shareholders

X<sub>2</sub>-X<sub>3</sub> are representative parameters of the corporation government.

NCON and X<sub>6</sub> are representative parameters of concentration of shareholders' equity. We also take the performance of the manage level who are inspirited into account and bring in the X<sub>5</sub>.

## 2) Output Variables

Y<sub>1</sub>: ROA, Return on asset

Y<sub>2</sub>: EPS, Earning Per Share

Y<sub>3</sub>: Core Earning Per Share

Y<sub>4</sub>:Tobin Q=Vi/Ai, Vi = the total market value of the firm , (i.e. the sum of the market value of equity, preferred stocks and debt); Ai = the book value of firm's total assets, proxy for firm size. It is the ratio of the market value of a firm's assets (as measured by the market value of its outstanding stock and debt) to the replacement cost of the firm's assets (Tobin 1969). This measure of performance is not used as often as either rates of return or price-cost margins.

## **2. Result and Analysis:**

In this section, Governance Efficiency index and Malmquist Governance Efficiency index are estimated for each enterprise, the average efficiency index and Malmquist index are reported, and the features of the frontier firms will be ascertained.

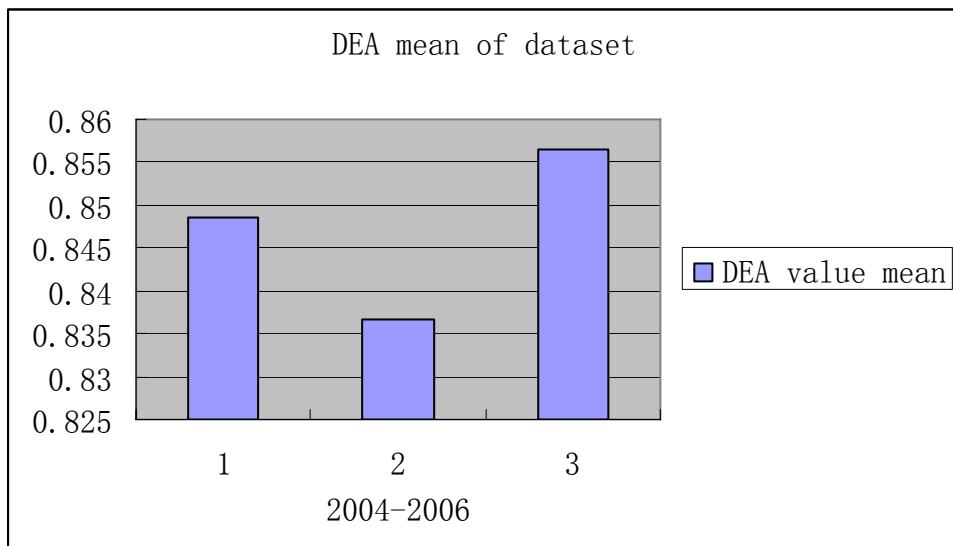
DEA value and Malmquist Governance Efficiency index of samples in different years can be observed on the table below:

*Table2: Calculated DEA Value*

Company code \ Year	2004	2005	2006
600031	1	1	1
000937	1	1	1
600018	1	1	1
600019	1	1	1
600069	0.677	0.567	0.867
600079	1	0.779	1
600098	0.712	0.95	0.632
600121	1	0.954	1
600325	0.641	0.49	0.371
600352	0.721	0.65	0.958
600398	0.802	1	0.809
600469	1	1	1
600500	1	0.543	0.959
600521	1	1	1
600550	0.509	1	0.768
600570	0.748	0.795	0.77
600580	0.587	0.754	0.708
600595	0.693	0.314	0.804
600886	1	1	1
600900	1	1	1
600973	1	1	1
000830	1	1	0.476
002001	0.638	0.496	0.526
002010	0.82	0.993	1

002014	0.915	1	0.697
002019	1	0.732	0.66
002021	0.356	0.404	0.621
002023	1	1	0.982
002024	1	1	1
002029	1	1	1
002032	0.49	0.518	0.947

In order to demonstrate the DEA value variation, we figure a bar chart of the DEA means in different years. And it shows that in 2005 the mean of DEA value decrease, however, it rises up sharply in 2006 and reaches a higher lever than year 2004. The charging trade of the DEA mean supports our analysis before.



Furthermore, we calculate Malmquist index to figure out this charging of the governance efficiency more clearly.

Table 3: Malmquist Governance Efficiency index

Company code	2004-2005	2005-2006	mean
600031	0.610	2.097	1.131
000937	0.653	0.972	0.796
600018	0.559	2.477	1.176
600019	0.570	1.169	0.816

600069	1.016	1.568	1.262
600079	1.477	0.893	1.149
600098	0.668	1.228	0.906
600121	0.630	1.236	0.882
600325	1.066	1.312	1.182
600352	0.753	3.102	1.528
600398	1.109	1.010	1.058
600469	1.119	1.434	1.267
600500	0.679	1.011	0.828
600521	0.717	1.398	1.001
600550	1.579	1.050	1.288
600570	0.780	1.990	1.246
600580	1.074	1.628	1.322
600595	1.206	1.122	1.163
600886	0.931	1.009	0.969
600900	0.532	1.588	0.920
600973	1.452	1.578	1.514
000830	0.966	0.588	0.754
002001	0.663	0.909	0.776
002010	0.775	1.561	1.100
002014	0.701	1.205	0.919
002019	0.425	1.573	0.818
002021	0.998	1.647	1.282
002023	0.670	1.138	0.873
002024	2.202	0.406	0.945
002029	0.746	1.836	1.170
002032	0.880	1.610	1.190
<b>mean</b>	<b>0.849</b>	<b>1.302</b>	<b>1.052</b>

Note that all Malmquist index averages are geometric means

From year 2004 to 2005, the efficiency of governance decreases by 15.1%, while in year 2006, it increases by 30.2%. Totally, the governance efficiency increases by 5.2% before the non-tradable shares reform.

With a panel dataset, it is of interest to study the stability of the efficient governance units. It strengthens the reliability of the approach if the same units appear on the frontier over time. It is also of importance to investigate the features of firms on the governance frontier and the

churning of firms on the frontiers in the context of China's economic reform.

We can distinguish the influence of shareholders' governance efficiency of corporation whose ownership structure are different with each other. The above analysis will also reflect the static relationship between firms' governance efficiency and the determinants of firms' governance efficiency. What's more, it will addresses how firms response to the dynamic competition, such as the intense competition between large firms despite the high concentration ratio, the entry of new firms, etc., and some other dynamic firm characteristics, such as the change of ownership, etc.

If competition is intense and the market selection process is effective, there is likely to be a convergence in the efficiency of competing firms. As firms strive to catch up with governance technology frontier to improve efficiency in order to be profitable and to survive, those lagging behind will be sorted out. If competition is intense, but the market selection process is not effective, there is likely to be divergence in firms' governance efficiency. As inefficient firms do not exit, which provides disincentives for firms to improve governance efficiency, at the same time new firms enter which drive forward the governance technology frontier.

In a word, Chinese listed companies must evaluate the shareholders' governance efficiency veraciously, and identify the diversiform

influences of shareholders' behavior to itself. Maybe the China non-tradable shares reform is the most prime chance to adjust the structure of equity structure which prevents the firm from prospering now. Our method to evaluate the efficiency of the shareholders' governance may reflect the validity of the reform in firms and also validates the function of the non-tradable shares reform by using consecutive data after 2005 to estimate the company's governance efficiency.

## **Summary and Conclusion Remark**

After the reform of non-tradable shares of listed corporations, listed corporations' state-owned share and corporate shares obtain the liquidity. "binary equity structure" disappear, equity structure changes, state-owned shares are diluted, the investors are multiform and the manner of benefit actualization of the non-circulation shareholders transforms. The shareholders' behavior will take a new look in this context. Corporate shares and foreign shares influence the corporations' achievement materially.

We bring forward a systemic evaluation method in base of DEA by analyzing the behavior of shareholders after the reform. This method is used in estimating the material influence to the corporations' achievement after the reform of non-tradable shares. And the calculated data support

that the corporate governance efficiency increases through the changing of the list companies share structure.

But our study has limitations. Because the reform of non-tradable shares of listed corporations period is relatively short. The influence of the non-tradable shares reform to the listed corporation should be traced.

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## Appendix:

### Dataset:

Year	Co. code	Y1	Y2	Y3	Y4	X1	X2	X3	X4	X5	X6
2004	600031	0.440	3.497	11.068	0.977	0.556	0.004	0.746	0.250	0.000	0.779
2004	000937	0.475	2.233	5.669	1.449	0.636	0.765	0.000	0.235	0.000	0.810
2004	600018	0.313	1.180	2.241	2.113	0.750	0.752	0.015	0.233	0.000	0.781
2004	600019	0.401	1.341	4.687	1.164	0.636	0.850	0.000	0.150	0.000	0.865
2004	600069	0.262	0.332	2.138	0.979	0.600	0.393	0.216	0.392	0.000	0.610
2004	600079	0.449	1.195	2.913	0.475	0.667	0.033	0.392	0.575	0.001	0.395
2004	600098	0.192	1.031	3.448	1.054	0.667	0.742	0.000	0.258	0.001	0.795
2004	600121	0.276	0.527	1.581	1.605	0.750	0.733	0.000	0.267	0.000	0.738
2004	600325	0.160	0.790	2.652	0.606	0.636	0.000	0.410	0.300	0.000	0.427
2004	600352	0.354	0.725	3.029	1.607	0.556	0.000	0.084	0.251	0.432	0.518
2004	600398	0.266	1.123	3.508	0.984	0.667	0.000	0.483	0.517	0.000	0.527
2004	600469	0.619	1.699	10.985	0.676	0.636	0.696	0.010	0.294	0.000	0.711
2004	600500	0.668	2.062	15.512	1.455	0.600	0.000	0.678	0.322	0.000	0.692
2004	600521	0.249	1.085	2.173	3.817	0.667	0.000	0.028	0.350	0.583	0.678
2004	600550	0.235	0.689	3.434	0.773	0.667	0.630	0.097	0.273	0.000	0.755
2004	600570	0.331	1.777	3.926	1.573	0.700	0.000	0.374	0.250	0.234	0.513
2004	600580	0.195	0.554	2.944	1.134	0.667	0.078	0.444	0.321	0.055	0.587
2004	600595	0.320	1.120	8.205	0.320	0.600	0.000	0.509	0.370	0.000	0.536
2004	600886	0.630	1.505	4.220	0.464	0.667	0.576	0.000	0.381	0.000	0.651
2004	600900	0.207	0.577	0.786	2.084	0.667	0.672	0.032	0.163	0.000	0.700
2004	600973	0.365	1.704	8.623	0.902	0.667	0.575	0.050	0.375	0.000	0.625
2004	000830	0.275	1.103	9.151	0.542	0.571	0.688	0.000	0.288	0.000	0.712
2004	002001	0.317	2.025	9.946	0.950	0.636	0.000	0.691	0.263	0.042	0.725
2004	002010	0.412	1.955	8.164	2.021	0.556	0.038	0.188	0.250	0.413	0.638
2004	002014	0.274	0.999	5.194	1.872	0.667	0.011	0.431	0.251	0.000	0.738
2004	002019	0.256	1.513	4.668	3.349	0.667	0.000	0.414	0.286	0.207	0.700
2004	002021	0.286	1.346	5.535	0.811	0.625	0.000	0.244	0.302	0.335	0.691
2004	002023	0.188	0.991	1.740	2.650	0.556	0.000	0.000	0.306	0.622	0.665
2004	002024	1.049	9.353	97.759	2.098	0.667	0.000	0.183	0.268	0.373	0.695
2004	002029	0.294	1.037	2.890	2.268	0.556	0.000	0.706	0.294	0.000	0.726
2004	002032	0.415	2.043	7.423	0.981	0.667	0.000	0.463	0.251	0.258	0.729
2005	600031	0.423	1.829	5.286	0.670	0.556	0.003	0.659	0.338	0.000	0.715
2005	000937	0.459	1.738	4.097	0.986	0.636	0.580	0.000	0.420	0.000	0.592
2005	600018	0.317	1.302	2.647	0.981	0.667	0.702	0.014	0.284	0.000	0.733
2005	600019	0.348	1.481	7.230	0.508	0.636	0.779	0.000	0.221	0.000	0.801
2005	600069	0.311	0.489	2.887	0.634	0.600	0.291	0.160	0.549	0.000	0.454
2005	600079	0.502	1.434	3.678	0.305	0.667	0.024	0.286	0.690	0.002	0.313
2005	600098	0.153	0.571	3.042	0.737	0.667	0.670	0.000	0.330	0.001	0.799

2005	600121	0.396	0.753	2.358	0.844	0.692	0.526	0.000	0.474	0.000	0.535
2005	600325	0.188	0.794	2.747	0.450	0.636	0.000	0.300	0.390	0.000	0.369
2005	600352	0.356	0.637	3.225	0.950	0.600	0.000	0.072	0.352	0.374	0.449
2005	600398	0.268	1.221	4.109	0.564	0.667	0.000	0.328	0.672	0.000	0.354
2005	600469	0.632	2.029	14.510	0.473	0.636	0.574	0.009	0.418	0.000	0.606
2005	600500	0.414	1.018	12.651	0.807	0.600	0.000	0.675	0.325	0.000	0.674
2005	600521	0.288	0.984	1.809	2.342	0.667	0.000	0.024	0.438	0.505	0.591
2005	600550	0.384	1.176	5.949	1.172	0.667	0.536	0.083	0.382	0.000	0.633
2005	600570	0.335	1.163	2.321	1.156	0.700	0.000	0.324	0.350	0.203	0.444
2005	600580	0.243	0.754	4.412	1.030	0.667	0.038	0.397	0.433	0.046	0.513
2005	600595	0.300	1.111	10.601	0.208	0.636	0.000	0.475	0.524	0.000	0.493
2005	600886	0.712	1.742	5.425	0.348	0.667	0.510	0.010	0.480	0.000	0.602
2005	600900	0.240	0.652	0.887	1.439	0.750	0.641	0.027	0.332	0.000	0.671
2005	600973	0.402	1.965	10.804	0.671	0.636	0.484	0.010	0.506	0.000	0.551
2005	000830	0.322	1.078	8.160	0.358	0.571	0.564	0.000	0.404	0.000	0.572
2005	002001	0.319	1.408	7.348	0.815	0.636	0.000	0.605	0.355	0.036	0.683
2005	002010	0.466	1.661	6.795	1.750	0.556	0.032	0.159	0.362	0.329	0.574
2005	002014	0.294	1.119	6.540	1.238	0.667	0.010	0.383	0.351	0.000	0.640
2005	002019	0.244	1.143	3.946	1.263	0.667	0.000	0.340	0.414	0.170	0.574
2005	002021	0.389	1.223	4.979	0.639	0.667	0.000	0.197	0.438	0.270	0.565
2005	002023	0.161	0.597	1.223	1.770	0.556	0.000	0.000	0.423	0.517	0.554
2005	002024	1.300	4.531	47.518	1.550	0.667	0.000	0.166	0.335	0.000	0.631
2005	002029	0.333	0.970	2.831	1.666	0.500	0.000	0.618	0.382	0.000	0.661
2005	002032	0.513	2.056	8.349	0.832	0.700	0.000	0.409	0.339	0.228	0.618
2006	600031	0.614	3.387	9.530	2.615	0.556	0.000	0.640	0.360	0.000	0.760
2006	000937	0.415	1.715	4.695	0.936	0.636	0.577	0.000	0.423	0.000	0.588
2006	600018	0.244	0.279	0.595	2.887	0.667	0.451	0.168	0.115	0.000	0.910
2006	600019	0.340	1.593	9.010	1.004	0.545	0.730	0.000	0.270	0.000	0.815
2006	600069	0.362	0.695	4.029	0.716	0.600	0.291	0.024	0.685	0.000	0.369
2006	600079	0.320	1.091	2.894	0.551	0.667	0.000	0.165	0.835	0.002	0.248
2006	600098	0.152	0.599	2.960	0.935	0.667	0.670	0.000	0.330	0.001	0.796
2006	600121	0.411	0.878	4.102	1.162	0.692	0.526	0.000	0.474	0.000	0.532
2006	600325	0.209	0.978	3.227	0.646	0.667	0.000	0.300	0.390	0.000	0.349
2006	600352	0.375	0.768	4.143	1.016	0.556	0.000	0.000	0.793	0.333	2.012
2006	600398	0.268	1.309	4.935	0.498	0.625	0.000	0.318	0.682	0.000	0.330
2006	600469	0.531	1.667	19.670	0.435	0.636	0.525	0.000	0.475	0.000	0.566
2006	600500	0.299	0.722	12.261	1.080	0.500	0.000	0.591	0.410	0.000	0.706
2006	600521	0.304	1.152	2.421	2.838	0.667	0.000	0.000	0.589	0.513	0.562
2006	600550	0.255	1.384	8.438	1.336	0.667	0.511	0.092	0.397	0.000	0.615
2006	600570	0.434	1.114	2.406	2.447	0.636	0.000	0.224	0.768	0.143	0.435
2006	600580	0.228	0.760	4.190	1.588	0.700	0.000	0.451	0.522	0.037	0.423
2006	600595	0.410	1.839	12.485	0.501	0.667	0.000	0.314	0.685	0.001	0.505
2006	600886	0.388	1.493	5.184	0.340	0.667	0.441	0.000	0.559	0.000	0.542

2006	600900	0.196	0.581	0.845	1.962	0.750	0.605	0.000	0.395	0.000	0.692
2006	600973	0.614	2.693	16.306	1.253	0.636	0.474	0.007	0.520	0.000	0.549
2006	000830	0.231	0.459	3.753	0.726	0.571	0.425	0.225	0.350	0.000	0.588
2006	002001	0.319	0.710	4.646	0.720	0.600	0.000	0.605	0.395	0.029	0.646
2006	002010	0.476	1.963	8.100	2.404	0.500	0.000	0.028	0.576	0.329	0.559
2006	002014	0.323	1.266	7.697	1.436	0.700	0.000	0.324	0.452	0.000	0.604
2006	002019	0.376	1.734	5.076	1.113	0.600	0.000	0.310	0.573	0.016	0.560
2006	002021	0.416	1.108	4.269	1.380	0.667	0.000	0.113	0.528	0.270	0.508
2006	002023	0.126	0.501	1.293	2.014	0.556	0.000	0.000	0.423	0.517	0.554
2006	002024	0.828	3.542	34.585	3.697	0.667	0.000	0.224	0.408	0.315	0.553
2006	002029	0.423	1.386	4.378	3.669	0.556	0.000	0.487	0.513	0.000	0.707
2006	002032	0.720	3.162	11.811	2.024	0.667	0.000	0.401	0.412	0.187	0.647

Data from CCER and CSMAR Database