Diversification Limited by Absence of Short Sales: the Chinese Case

Yan Zhou

Advisor : Professor René Garcia
Professor Nour Meddahi

Département de Sciences Économiques
Université de Montréal

August 2003

Abstract

Portfolio diversification for investing in the Chinese stock market is analyzed under the constraints on short selling. For verifying whether short-sales restrictions affect the diversification and the efficiency of the market, significant co-movement of stock returns is investigated by using the approach developed by Morck *et al.* In a market where short selling is prohibited, higher co-movement implies less efficient price discovery as well as less efficient diversification in the market since specific stock information is presumably a driver of any deviation in co-movement among stocks. Currently, a lot of theoretical work argues that a stock could be massively overpriced if shorting stocks is impossible in a market. Therefore, the mispricing problem is also examined by measuring the alphas in the CAPM model for the Chinese market. We conclude that the co-movement of stock returns in the Chinese market is high, but there are no mispricing problems found according to the results of the alphas of CAPM.

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I. INTRODUCTION

In security markets, return always exists with risk even though people generally prefer the return rather than the risk. Diversification is dedicated to assemble a portfolio of assets in order for reducing risk while obtaining the optimal return. The important point of diversification is the correlation between asset fundamentals. If the fundamentals of the listed firms are highly correlated and hence their stock prices are highly synchronous, it will be difficult to reduce the risk and obtain the optimal return at the same time.

Short sales regulation is an important element of capital market microstructure. A lot of theoretical work argues that short sales regulation has significant effects on information aggregation due to its asymmetric impact on investors with favorable and unfavorable information. It has been shown that risky asset prices are higher than those that would prevail in a similar economy where short sales were unrestricted. Up to now, however, very little has been known about the empirical work as well as the associated results for validating the overvaluation hypothesis.

In this paper, we use time series information to examine whether there exist short sales in the Chinese market by measuring the effect of short sales regulation on diversification. As will be depicted in this paper, the Chinese stock market informally prohibited short sales before and formally prohibits short sales now. Therefore, the cases without short sales regulation may not be found in the Chinese market and compared with the current Chinese market with short sales regulation.

The analysis operates on the data available and employs the measures proposed by other researchers. Our results can only be compared with the results obtained from the markets in several other countries where short sales are allowed.

Using the CAPM model, we show that better diversification and more efficient price discovery can be made by short sales of the overpriced stock in theory. The mispricing problem possibly resulted from the regulation for prohibiting short sales is also examined by measuring the alphas of the CAPM model.

Using the synchronous price approach developed by Mørck, Yeung and Yu [MYY], we find that in of the Chinese market, there is significantly less cross-sectional variation in stock returns that would be found in markets where short sales are prohibited. This evidence is consistent with less efficient price discovery at the individual security level.

We look for evidence to support the view that short selling facilitates efficient price discovery—at least to the extent that efficiency is captured empirically by the lack of synchronous movement in returns. We are able to show that short sales may play an important role in the efficiency of the Chinese market.

The paper is organized as follows. The next section reviews the pertinent information, and Section III reviews the theory associated with short sales regulation. Section IV reports the empirical results and the synchronous price test of relative pricing efficiency, and reports statistical characteristics of market and security returns associated with the mispricing problem. Section V concludes.

II. CHINESE STOCK EXCHANGE

The major Chinese securities exchanges were opened in the early 1990s. There are two Houses of Stock Exchange in the mainland of China, the Shanghai Stock Exchange and the Shenzhen Shock Exchange. The first one was established in the traditional pre-socialist financial center of Shanghai in December 1990, and the second one was opened in the Special Enterprise Zone (SEZ) of Shenzhen in April 1991. The two exchanges have been expanding rapidly since their establishment, such that the Chinese stock market has become the second largest market in Asia, behind Japan. At the end of the year 2000, the total market capitalization amounted to 580 billion US dollars, which was greater than that of the Hong Kong and Taiwan markets. The speculation is that the Chinese securities market has the potential to rank among the top four or five in the world in the coming decade (Ma and Folkerts-Landau 2001).

Chinese incorporated enterprises can issue multiple classes of shares. The Class A and Class B shares are issued and traded in either of the exchanges, but the companies are not allowed to be cross-listed. The Class A shares are purchased in the Chinese currency by domestic Chinese investors, whereas the Class B shares are limited to the U.S. Dollar in the Shanghai market and the Hong Kong (HK) Dollar in the Shenzhen market. The Class B shares are officially defined as foreign-capital shares listed in domestic market, and were available only for foreign investors until February 19, 2001. The first B share was issued in the Shanghai Stock Exchange in 1992. There is another class of shares, the Class H shares, issued by the Chinese firms in the Hong Kong exchange. However, the Class H shares are not considered in this paper. In the sequel, the two classes of shares may be simply called A shares and B shares, respectively.

There were many adjustments about rules, laws, and policies in the 12 years of the

Chinese stock market history. Only three important adjustments related with our analysis are introduced as below:

(1) Stock transactions of both classes of shares were originally settled on a T+0 period. This means that investors could sell the stocks that they had bought during the same day. The transactions of Class A shares have been settled on T+1 since January 1, 1995. That is, investors could only sell their stocks on the first business day after the day the deal was made. The transactions of Class B shares remained in a T+0 cycle till Mar 2001, and the settlement is now T+3.

(2) Since December 16, 1996, the price change scope has been limited. The rule ordains the market price rising and dropping scopes not to surpass 10%. Before this, the stock price change scope was unlimited.

(3) There were no rules that clearly allowed short sales when the Chinese stock market was established. The rules prohibiting short sales on A shares were formally decreed on April 10, 1996, whereas the rules prohibiting short sales on B shares were formally decreed on November 14, 1996. These rules ordain that short selling a stock is an offense against the regulation and fines can be laid. In China, the inexistence of rules for prohibiting short sales could be deemed a prohibition of short sales. Therefore, we would suppose that short sales are never allowed in the Chinese stock market.

III. Theoretical Analysis

3.1 The Principle of Diversification

Diversification is dictated to assemble a portfolio of assets in order to reduce risks, including systematic and idiosyncratic risks. Systematic risk or market risk cannot be diversified away. Idiosyncratic risk, however, is capable of being reduced by diversification.

A single index model shows the difference between the market risk and idiosyncratic risk. This model assumes that stock returns can be divided into common factor returns, called systematic returns, and idiosyncratic returns. A common factor return is the return on the market portfolio and can be represented by

$$r_{it} = \alpha_i + \beta_i r_{Mt} + \varepsilon_{it} \tag{1}$$

where statistical properties are specified by

$$\varepsilon_{it} \sim N(0, \sigma_{\varepsilon i}^2) \tag{2}$$

$$\operatorname{cov}(r_{Mt}, \varepsilon_{it}) = 0 \quad \operatorname{cov}(\varepsilon_{it}, \varepsilon_{jt}) = 0, i \neq j \tag{3}$$

Let the expectation of returns on stocks be

$$E(r_{it}) = \alpha_i + \beta_i E(r_{Mt}) \tag{4}$$

and let the variance of returns be

$$\sigma_i^2 = \beta_i^2 \sigma_M^2 + \sigma_{\varepsilon i}^2 \tag{5}$$

The covariance between i and j is given by

$$\sigma_{ij} = \beta_i \beta_j \sigma_M^2 \quad \text{if } i \neq j \tag{6}$$

where $\beta_i^2 \sigma_M^2$ is systematic risk and $\sigma_{\varepsilon i}^2$ is idiosyncratic risk. Diversification can reduce $\sigma_{\varepsilon i}^2$, but $\beta_i^2 \sigma_M^2$ cannot be diversified away.

The goal of diversification is to reduce idiosyncratic risk. The principle of diversification is to assemble a portfolio and reduce its risk. Let us illustrate this with a simple example of two assets.

In the case of minimal total variance, if there are two returns of available assets R_1 and R_2, R = (R_1, R_2) with mean μ and variance-covariance Ω, the return of the portfolio is R_p and its variance is σ_p^2. Let ω_1 be the weight on asset R_1. Then $(1-\omega_1)$ is the weight on asset R_2. We have

$$R_p = \omega_1 R_1 + (1-\omega_1) R_2 \tag{7}$$

$$\sigma^2{}_p = \text{var}(R_p) \tag{8}$$

$$\sigma^2{}_p = \omega_1^2 \sigma_1{}^2 + (1-\omega_1)^2 \sigma_2{}^2 + 2\omega_1(1-\omega_1)\sigma_{12} \tag{9}$$

where $\sigma_1^2 = \text{var}(R_1)$, $\sigma_2^2 = \text{var}(R_2)$, and $\sigma_{12} = \text{cov}(R_1, R_2)$.

Diversification is aimed to reduce the variance of the portfolio. Therefore, the minimum variance of the portfolio σ_p^2 is derived as follows:

$$\min_{\omega} \sigma^2{}_p = \omega_1^2 \sigma_1{}^2 + (1-\omega_1)^2 \sigma_2{}^2 + 2\omega_1(1-\omega_1)\sigma_{12} \tag{10}$$

$$\frac{\partial \sigma_p^2}{\partial \omega_1} = 2\omega_1^* \sigma_1^2 - 2(1-\omega_1^*)\sigma_2^2 + 2\sigma_{12} - 4\omega_1^* \sigma_{12} \tag{11}$$

The optimal solution to this problem is given by setting $\frac{\partial \sigma_p^2}{\partial \omega_1} = 0$. Then

$$\frac{\partial \sigma_p^2}{\partial \omega_1} = 2\omega_1^* \sigma_1^2 - 2(1-\omega_1^*)\sigma_2^2 + 2\sigma_{12} - 4\omega_1^* \sigma_{12} = 0 \qquad (12a)$$

Therefore,

$$\omega^* = \frac{\sigma_2^2 - \sigma_{12}}{\sigma_1^2 + \sigma_2^2 - 2\sigma_{12}} \qquad (12b)$$

To illustrate the advantage of diversification, let us look at the derivative $\frac{\partial \sigma_p^2}{\partial \omega_1}$, where no money is invested in asset 1:

$$\frac{\partial \sigma_p^2}{\partial \omega_1} = \omega_1^* (\sigma_1^2 + \sigma_2^2 - 2\sigma_{12}) - \sigma_2^2 + \sigma_{12} \qquad (12c)$$

$$\left.\frac{\partial \sigma_p^2}{\partial \omega_1}\right|_{\omega_{1=0}} = \rho_{12}\sigma_1\sigma_2 - \sigma_2^2 \qquad (12d)$$

$$\left.\frac{\partial \sigma_p^2}{\partial \omega_1}\right|_{\omega 1=0} = \sigma_1\sigma_2(\rho_{12} - \frac{\sigma_2}{\sigma_1}) \qquad (12e)$$

The advantages of diversification can be seen by considering the values of ρ_{12}:

(1) $\rho_{12} < 0$, $\left.\frac{\partial \sigma_p^2}{\partial \omega_1}\right|_{\omega_1=0} < 0$:

We can reduce the variance by increasing asset 1,

(2) $0 < \rho_{12} < \frac{\sigma_2}{\sigma_1}$, $\left.\frac{\partial \sigma_p^2}{\partial \omega 1}\right|_{\omega 1=0} < 0$:

We can reduce the variance by increasing asset 1.

(3) $\rho_{12} > \frac{\sigma_2}{\sigma_1}$, $\frac{\partial \sigma_p^2}{\partial \omega 1}|_{\omega 1=0} > 0$:

We can reduce the variance while short selling asset 1.

Obviously, in the absence of short sales, Case (3) above does not exist, and diversification is limited.

This simple example with two assets shows that the correlation is very important when portfolios are constructed. If correlations of assets in the portfolio are significantly positive, it is difficult to reduce the risk of the portfolio when short sales are prohibited. This means that in the stock market, the fundamentals of listed firms will be highly correlated and their stock prices will become highly synchronous. The difficulty of diversification is increasing in the case that short sales are prohibited. In other words, more co-movement of stock returns implies less efficient diversification in the market.

3.2 The CAPM Model

The Capital Asset Pricing Model (CAPM) based on Markowitz's (1952, 1959) portfolio theory is one of the most important theoretical developments in finance that explains the effect of short sales restriction in theory. The CAPM suggests that investors hold mean-variance efficient portfolios (well-diversified portfolios). Investors like higher expected returns and dislike variance (risk). There is an important implication of the notion of mean-variance efficient portfolios. The risk of mean-variance efficient portfolios is its variance, whereas the risk of a particular asset is not its own variance. The logic works as follows. You care about the variance of the portfolio – not of individual assets. A particular asset might have greater or lower variance than the portfolio. However, it does not make any sense to reward the asset based on its own variance. Correlation is the missing ingredient. A very high variance asset possibly reduces the overall portfolio variance because it has low or negative correlation with the portfolio returns. Indeed, one can think of this high volatility asset with low correlation as providing insurance or hedging for the overall portfolio.

There are numerous ways to derive the CAPM. We will not go into the different ways. However, some of the most important assumptions are that investors only care about mean and variance, asset returns are multivariate normally distributed (or equivalent assumptions on investor utility could be made to replace this assumption), capital markets are perfect (all information is correctly reflected in prices as in Fama (1970), there are no transactions costs, no taxes, etc.), there are no disagreements about the returns distributions.

All of these assumptions are counterfactual. However, they provide a framework to derive a simple model that has rich implications.

A. CAPM and Short Sales

In the CAPM theory, mean-variance efficient portfolios play an important role. Mean- variance efficient portfolios are corresponding to the best diversification portfolio in the market. Such portfolios constructed using sample moments often involve large negative weights in a number of assets. Since negative weights (short positions) are difficult to implement in practice, most investors impose the constraint that portfolio weight should be nonnegative when constructing mean-variance efficient portfolios.

Let there be *N* risky assets with mean vector μ and covariance matrix Ω. For an arbitrary portfolio *a* with weight summing to unity, assume the expected returns of ω_a

to be an ($N \times 1$) vector of portfolio weights. The portfolio a has mean return $\mu_a = \omega_a{'}\mu$ and variance $\sigma_a^2 = \omega_a{'}\Omega\omega_a$.

A portfolio is the minimum-variance portfolio with mean return μ_p if the weight vector is the solution to the following constrained optimization

$$\min_{\omega} \tfrac{1}{2}\omega{'}\Omega\omega \tag{13}$$

which is subject to

$$\omega{'}\mu = \mu_p \quad (\sum_{i=1}^{N} \omega_i \mu_i = \mu_p)$$

$$\omega{'}\tau = 1 \qquad (\sum_{i=1}^{N} \omega_i = 1)$$

The solution to this problem can be characterized as the solution to

$$\min_{(\omega,\lambda,\gamma)} L \tag{14}$$

where L is the Lagrangian:

$$L = \tfrac{1}{2}\omega{'}\Omega\omega + \lambda(\mu_p - \omega{'}\mu) + \gamma(1 - \omega{'}\tau) \tag{15}$$

The solution of Lagrangian can help trace the efficient frontier.

If short sales are not allowed, the weights are not negative, then

$$\min_{\omega} \tfrac{1}{2}\omega{'}\Omega\omega$$

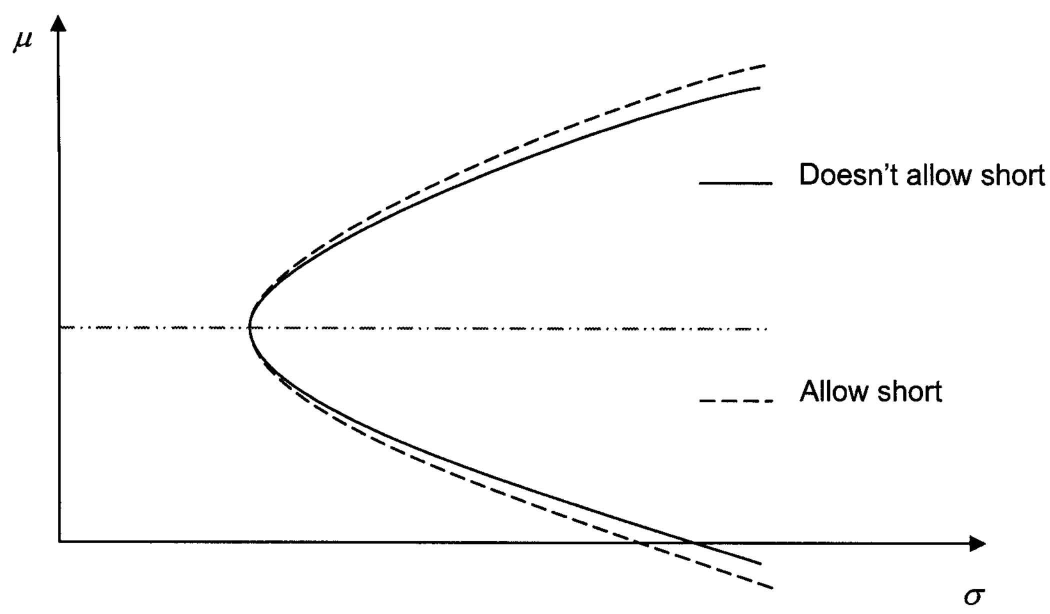
which is subject to

$$\omega'\mu = \mu_p \quad (\sum_{i=1}^{N} \omega_i \mu_i = \mu_p)$$

$$\omega'\tau = 1 \qquad (\sum_{i=1}^{N} \omega_i = 1)$$

$$\omega \geq 0$$

We can trace another efficient frontier in the same way. If we put these two frontiers in the same graph, we see the difference.



This shows that some of the efficient frontier portfolio weights should be negative. It means that we can make better diversification by allowing the short sales. In this way, we can get more returns for a given risk or less risk for a given return, and that is efficiency.

Lintner (1971) analyzed the effect of short selling and margin requirements on the CAPM and proved that a restriction on the use of short sales procedure will not affect the optimal demand from investors. However, he also speculated "when short selling is prohibited for any investors in the market, the market equilibrium set of current prices will not be the same as when there were no restrictions on short selling." Ross (1977), using a numerical example, demonstrated that the traditional CAPM breaks down if there are short sales restrictions in the market. Finally, Dybvig (1984) demonstrated that the mean-variance efficient-frontier could be kinked if short sales are constrained in the financial markets.

B. CAPM and Finding "Mispriced" Securities

CAPM is a static equilibrium model built on the perfect market (all information is correctly reflected in prices, and there are no transactions costs, no taxes, etc.). In a perfect market, prices are "correct" in the sense that the prices reflect fundamental equilibrium value.

As an equilibrium model, all assets and portfolios will have the same return after adjustment for risk. In other word, in the CAPM world, all arbitrage trades have zero marginal profit, implying:

$$E[r_i] = r_f + \beta_i (E[r_m] - f_f) \tag{16}$$

Superior performance in the CAPM world is measured by "alpha", which is the incremental expected return resulting from managerial information (e.g. stock selection). This can be represented formally as

$$\alpha_i = E[r_i] - r_f - \beta_i (E[r_M] - r_f) \tag{17}$$

Alpha (α) of security = "abnormal return": difference between actual expected return and the expected return predicted by CAPM:

- $\alpha > 0$: the security is under-priced: buy it (buy low!) and hope prices go back to equilibrium profit.
- $\alpha < 0$: the security is over-priced: short-sell it (sell high!)

In the CAPM world, alphas will be zero unless there is mispricing. A portfolio with positive alpha offers an expected return in excess of its equilibrium risk-adjusted level and in this sense the security is under-priced; alternatively, the portfolio is over-priced.

When shorting a stock is impossible in a market, it is said that there is an infinite transaction cost for short sales in the market. In this case, a stock could be massively overpriced. An asset pricing model with short sales restrictions was explored by Lai, Mak, and Wang (2001). It was shown by this model that when a market is too hot, investors cannot short sell to bring the price into equilibrium and that when there is excess demand in the market, the unfilled demand will push prices up since no one can short sell. Jones and Lamont (2001) reported evidence that binding short sales restriction can lead to overpriced stocks. Choie and Hwang (1994) reported that stocks at a large short position consistently underperform the market, implying that the prices of those stocks are higher than predicted by the CAPM.

Apparently, both theoretical and empirical evidences indicate that the assumption of no restrictions on short sales could be a problem when applying the CAPM in the real world. However, even with a clear understanding of the limitation, the CAPM and its variants are still being used extensively in the finance literature. This is probably because finance researchers feel that the problem is not serious enough for them to discard the model. Indeed, while it is true that investors will not be able to take a large short position in a particular stock, short sales of reasonable sizes are still allowed for most stocks in the market. Given this, it might make sense for the empirical finance literature to ignore the assumption of unlimited short sales when analyzing asset returns.

IV. Empirical Analysis

4.1 Data Source

The study covers the period from January 1, 1991 through December 31, 2002. The data come from private sources in several Chinese securities firms. The sample data cover almost all of the A and B share stocks that are traded in the Chinese stock market since Chinese Stock Exchanges were established.

The data employed in this study consist of weekly returns and monthly returns. Weekly security returns were computed by using daily closing prices, and monthly security returns were computed by using weekly closing prices. The date of the last observation is December 31, 2002, but the dates of the initial observations vary according to data availability. The market portfolio returns were based on the weekly index or monthly returns. The indices used in this study include the Shanghai Stock Exchange Index (SSE), the Shanghai Stock Exchange A shares Index (SSE-A), the Shanghai Stock Exchange B shares Index (SSE-B), the Shenzhen Stock Exchange Index (SZS), the Shenzhen Stock Exchange A share Index (SZS-A), and the Shenzhen Stock Exchange B share Index (SZS-B). The individual share data employed in the study cover 719 Shanghai A shares, 54 Shanghai B shares, 502 Shenzhen A shares, and 59 Shenzhen B shares. All of the data have been adjusted for dividend issues, stock splits, rights and bonus distribution, and currency of denomination. The risk-free rate was based on the return rate of the 3-year Treasury.

4.2 Measures of Stock Price Synchronicity

A. Co-movement (MYY)

The question in our analysis is whether short–sales restrictions play a role in efficient price discovery. As the voluminous literature on the efficient market theory suggests, there is no universal test for relative market efficiency, although event studies and filter rules have a long history of application. Randall Morck, Bernard Yeumg and Wayne Yu (2000) developed their basic synchronicity measures (MYY): co-movement of stock returns. An important contribution to the literature on market efficiency is MYY's observation that more efficient markets can be expected to have more idiosyncratic risk since the ratio of firm-specific information to market-level information is likely to be higher in informational environments that allow market participants to acquire information and act quickly and inexpensively upon it. They showed that stock prices move together more in emerging economies than in developed economies. In other words, higher fundamental correlation can be found in emerging economies.

In our analysis, we will use the MYY measure to examine whether there are high fundamental correlations in the Chinese stock market. As we stressed in the theoretical section, if fundamental correlations of assets in the portfolio are very high, it is difficult to reduce the risk of the portfolio when short sales are prohibited. Since diversification appears a difficulty. In other words, more co-movement of stock returns implies less efficient diversification in the market.

We use the MYY measure as a proxy for market efficiency, and then test whether cross-sectional differences in short–sales constraints correlate well to it.

Following MYY, for every year, we calculate two aggregate measures of individual security co-movement.

We compute the ratio:

$$f_t = \frac{\max\{n_t^{up}, n_t^{down}\}}{n_t^{up} + n_t^{dowm}} \quad (18)$$

where n_t^{up} is the number of stocks whose prices rise in week t, n_t^{down} is the number of stocks whose prices fall in week t. We then average the f_t's for each year, that is:

$$f_T = \sum_{t=1}^{\delta_T} f_t \Big/ \delta_T \quad (19)$$

where δ_T is the number of trading weeks in year T. We drop stocks whose prices do not move to avoid bias due to non-trading. Thus we define f_T as the average values of f_t in equation (18) across periods. The ratio of stocks moving together varies between 0.5 and 1; numbers closer to 1 indicate more co-movement. MYY argue that more co-movement implies less efficient price discovery and diversification in the market since stock specific information is presumably the driver of any deviation in co-movement among stocks.

Table I presents the results of MYY measures of the stock prices synchronicity for Shenzhen A, Shenzhen B, Shanghai A, and Shanghai B, respectively. The MYY measures are also plotted in a set of four figures (Figure 1,2,3,4). Note that the MYY measures for A and B shares are quite similar. It is obvious from Table I that there is high co-movement in the Chinese stock market.

In the Chinese stock market, the two stock exchanges have expanded rapidly in the last decade. The quantity of listed companies has increased almost 100 times and the market value has been enhanced 400 times. However, the MYY measures only decreased a little. We may conclude that the MYY measure is typically 80%, which is higher than that of the market where short sales are allowed. Randall Morck, Bernard Yeumg and Wayne Yu have found that 57.9% of stocks moved together in the average week of 1995 in United States while the measures were 58.3% and 59.2% in Canada and France, respectively. As stated above, the high MYY measures in Table I imply less efficient price discovery and more difficult diversification in the Chinese stock markets.

B. R-square statistic R^2

Cross-sectional idiosyncratic risk is another potential way to capture co-movement among stocks since specific stock information is presumably the driver of any deviation in co-movement among stocks. We thus compute an alternative measure of stock prices synchronicity, the R-square statistic (R^2), using the linear regression:

$$r_{it} = \alpha_i + \beta_i r_{mt} + \varepsilon_{it} \tag{20}$$

where r_{it} is the return of stock i in week t, r_{mt} is the market index return, α_i and β_i are two scalars.

For every firm *i* and every year *T*, we regress weekly stock returns on the value-weighted market return according to equations (20), where weeks *t* belong to year *T*. We will obtain R_{iT}^2 for each stock in each year. Then, we average the R_{iT}^2 obtained for every year *T*.

$$R_T^2 = \frac{\sum_i R_{iT}^2 SST_{iT}}{\sum_i SST_{iT}} \tag{21}$$

where SST_{iT} is the sum of squared variations in regression (20) and is given by.

$$SST_{iT} = \sum_{t=1}^{\delta_T} (r_{it} - \bar{r}_{it})^2 \tag{22}$$

Similar to the MYY measure, a higher R^2 indicates that stock prices frequently move together, implying less idiosyncratic risk.

Our results show that in terms of R-square statistic, there is also high co-movement in Chinese stock market. The R^2 measures of the stock prices synchronicity are presented in Table II for Shenzhen A, Shenzhen B, Shanghai A, and Shanghai B, respectively. The R^2 measures are also plotted in a set of four figures (Figure 5,6,7,8). Like the MYY measures, the R^2 measures for Shenzhen A and Shanghai A are similar. Even though R^2 has a decreasing trend (about 0.7 in 1993,wherwas 0.5 in 2002) against the increasing number of listed companies (A shares market has a total of 155 listed companies in 1993, whereas it was 1200 in 2002). Table V presented the number of listed companies from 1991 to 2002 in our study. It is typically higher than the R^2 of the United States who allows short sales. Goetzmann et al reported that the R^2 of the United States was only 0.021 in 1995. Similarly, based on the results of R^2, we may also argue there are less efficient price discovery and more difficult diversification in Chinese stock market.

We notice that the R^2 measure of A shares decreased quickly from 1995 to 1996. The reason might be that the stock exchange adjusted some rules during this period, such as implementing T+1 stock transaction and limiting the scopes of stock price rising and dropping. These adjustments might be affecting some idiosyncratic risk. However, market risk was still high since short sales are not allowed.

It should be pointed out that R^2 of B shares has an increasing trend along with the increasing number of listed companies. We have noticed that the B shares market has been presenting higher stock prices synchronicity than the A shares market since 1997 (Chinese stock exchange established the rules that prohibit short sales in 1996.)

4.3 Measure of Mispricing

In the CAPM world, alphas will be zero unless there is a mispricing problem. A portfolio with positive alpha offers an expected return in excess of its equilibrium risk-adjusted level and in this sense the security is under-priced; alternatively, the portfolio is over-priced.

This can be represented formally as

$$\alpha_i = E[r_i] - r_f - \beta_i(E[r_M] - r_f) \tag{23}$$

where the alpha (α) of the security represents "abnormal return"; the difference between the actual expected return and the expected return predicted by CAPM.

- If $\alpha > 0$, the security under-priced: buy it (buy low!) and hope prices go back to equilibrium profit.
- If $\alpha < 0$, the security over-priced: short-sell it (sell high!)

Our study considers the market as a portfolio for calculating the α of CAPM. In other words, we want to know if the mispricing problem can be predicted by CAPM in the Chinese stock market. We use the linear regression:

$$E_i[r_{it}] - r_f = \alpha + \beta(r_{mt} - r_f) + \varepsilon, \quad t = 1,2,\cdots,12, \tag{24}$$

where t represents a month, $E_i[r_{it}]$ is the monthly return of the portfolio, r_{mt} is a monthly market index return, and r_f is the free risk rate.

Estimation of the model parameter in equation (24) must address several econometric problems. There are deviations from the assumptions of CAPM that returns are jointly normal and IID through time. We consider tests that accommodate non-normality, heteroskedasticity, and temporal dependence of return. This test is of interest for one reason. Departures of monthly security returns from normality have been documented by Fama (1965, 1976), Blattberg and Gonedes (1974), Affleck- Graves and McDonald (1989). There is also abundant evidence of heteroskedasticity and temporal dependence in stock return. Even though temporal dependence makes the CAPM unlikely to hold as an exact theoretical model, it is still of interest to examine the empirical performance of the model. It is therefore desirable to consider the effects of relaxing these statistical assumptions.

We estimate this model using two ways. First, we average the monthly stock returns, then regress the model. Second, regress for individual stock monthly stock return, and then compute the average alphas obtained above over all stocks. We drop the new issue stock in each year to avoid bias due to the anomaly change of new stock. The results of two ways are very similar

We use OLS (ordinary least squares) estimate equation (24) based on monthly data. Table III and table IV juxtaposes the result. The results are also plotted in a set of four figures (Figure 9, 10, 11, 12). These results show that α of CAPM fluctuated near zero. It is not always negative and most of them are statistically insignificant. Therefore, we may not use the result and model to argue that the mispricing problem can be predicted by the CAPM in the Chinese stock market.

V. CONCLUSION

Restrictions on short selling shares are nearly as old as stock markets themselves. We study it in a relatively new stock market, the Chinese stock market. We study whether short-sales restrictions affect the diversification and efficiency of the market.

Most academic researchers make a strong theoretical case for allowing short sales in the market. Their case is based upon the notion that there exist markets to facilitate the efficient pricing of assets and that restricting short sales reduces market efficiency. Recent empirical evidence explored by several researchers, particularly Jones and Lamont (2001), provides some support for the hypothesis that difficulty in short selling is associated with security mispricing.

In this paper, empirical evidence in support of the first view has been found. There is high stock price synchronicity in the Chinese stock market. It indicates less efficient price discovery and more difficult diversification in the Chinese stock market. However, we cannot argue that there is a mispricing problem in the Chinese stock market by measuring the alpha of CAPM.

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Table I. MYY Measures of Stock Prices Synchronicity of Shenzhen A, Shenzhen B, Shanghai A, and Shanghai B

YEAR	SHENZHEN A	SHENZHEN B	SHANGHAI A	SHANGHAI B
1991	0.873718	0	0.836343	0
1992	0.874146	0.812500	0.877463	0.871752
1993	0.900562	0.811565	0.857957	0.780794
1994	0.902189	0.728621	0.851192	0.740748
1995	0.831372	0.682573	0.840964	0.743104
1996	0.801905	0.734370	0.801421	0.694498
1997	0.767858	0.759599	0.748421	0.750058
1998	0.728719	0.743947	0.700443	0.824329
1999	0.741134	0.798537	0.745276	0.789680
2000	0.694009	0.781246	0.698374	0.851043
2001	0.747205	0.842002	0.744978	0.904753
2002	0.771205	0.848979	0.777812	0.878626
2003	0.753526	0.848787	0.757011	0.860927

The fraction of stocks moving together:

$$f_t = \frac{\max\left[n_t^{up}, n_t^{down}\right]}{n_t^{up} + n_t^{dowm}}$$

where n_t^{up} is the number of stocks whose prices rise in week t, and n_t^{down} is the number of stocks whose prices fall in week t. The f_t's are averaged for each year:

$$f_T = \sum_{t=1}^{\delta_T} f_t \Big/ \delta_T$$

where δ_T is the number of trading weeks in year T.

Figure 1. MYY Measures of Stock Prices Synchronicity of A share

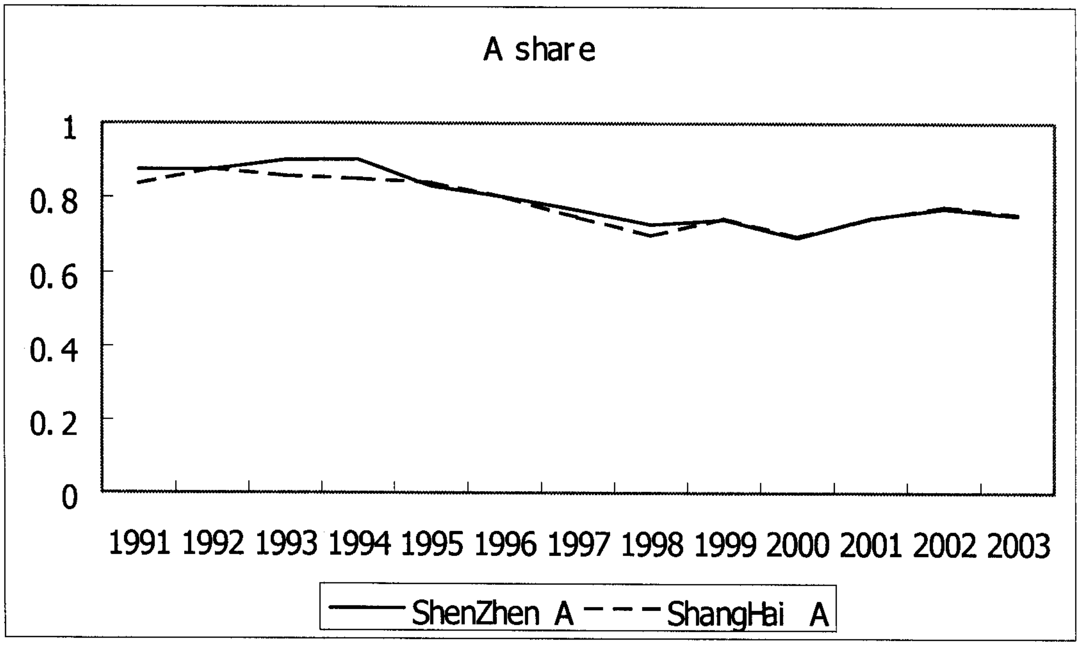
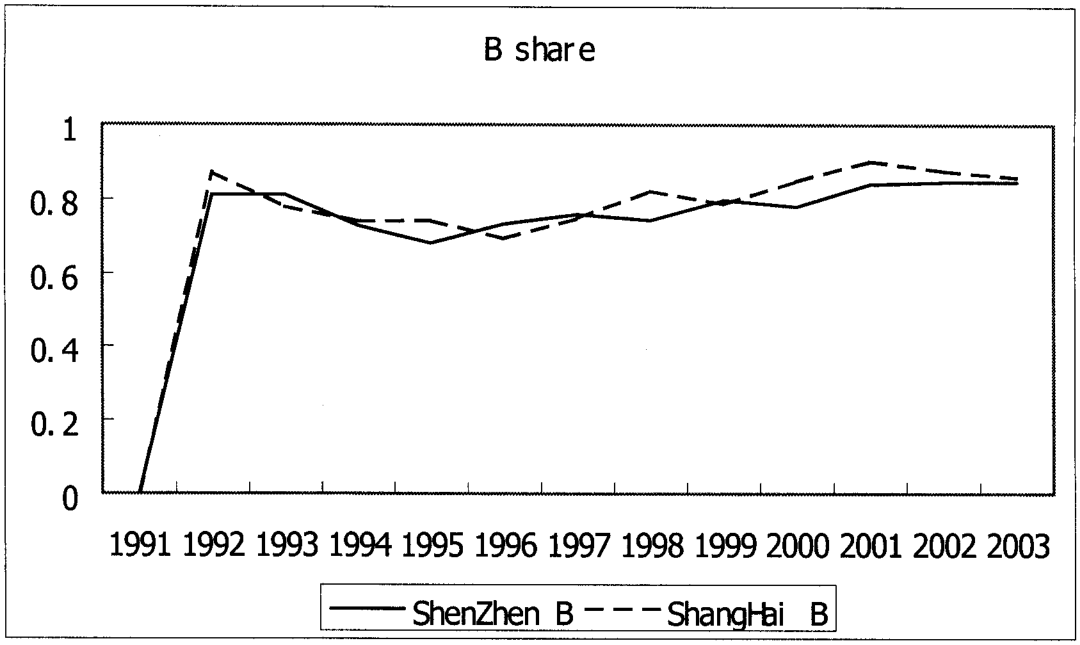


Figure 2. MYY Measures of Stock Prices Synchronicity of B share



(Remark: before 1992, there were not B shares in the market, so f_t was equal to 0 in 1991.)

Figure 3. MYY Measures of Stock Prices Synchronicity in ShenZhen stock market

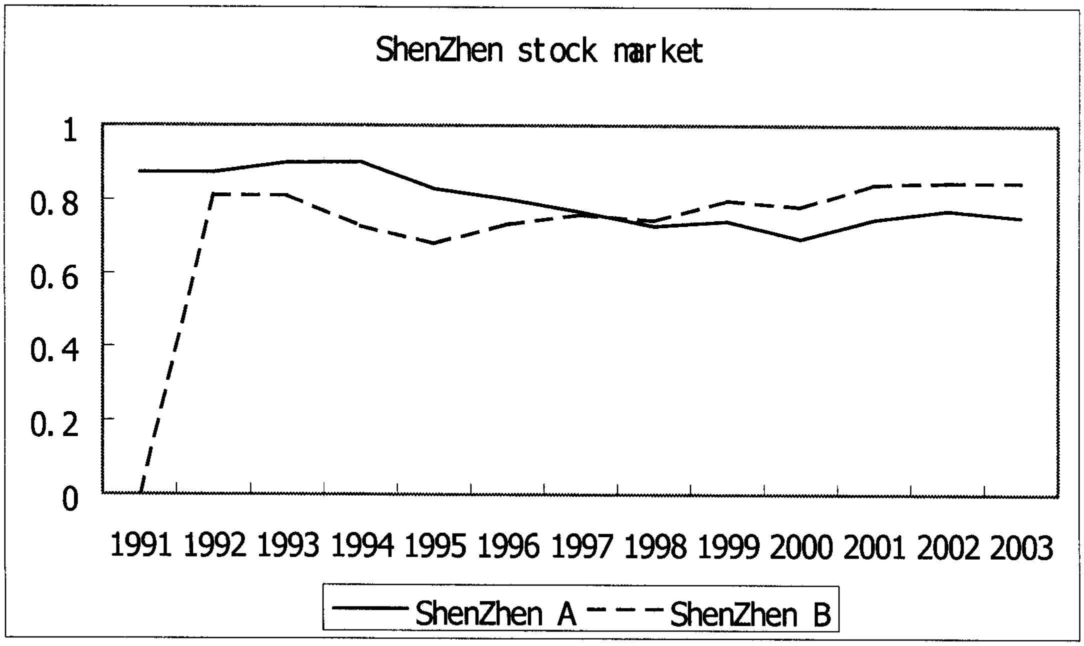


Figure 4. MYY Measures of Stock Prices Synchronicity in ShangHai stock market

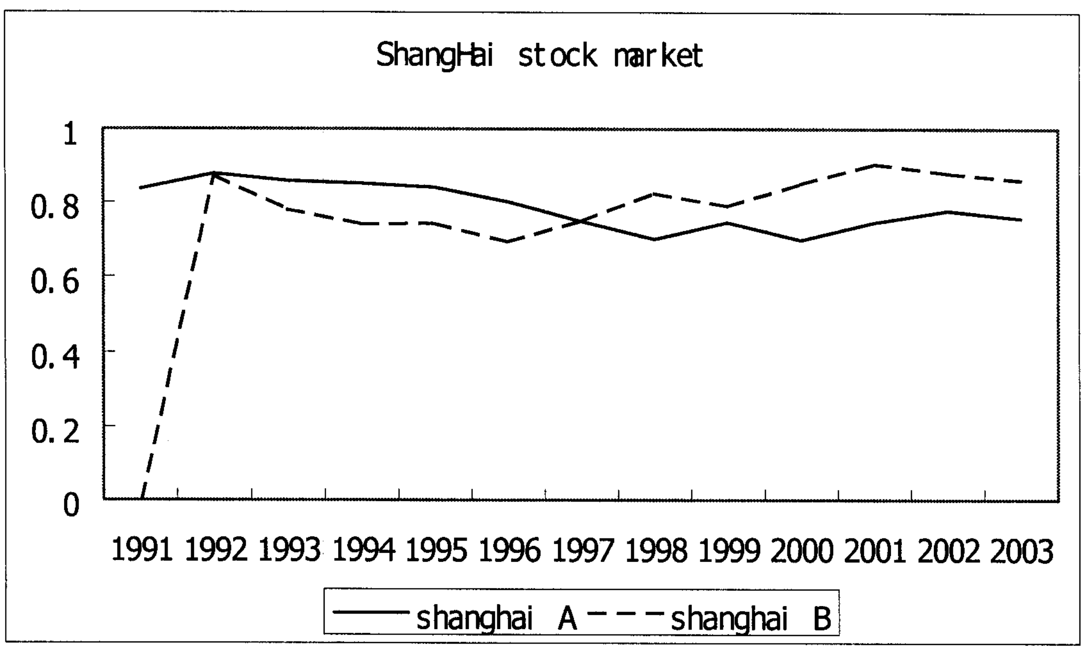


Table II. R^2 Measures of Stock Prices Synchronicity of Shenzhen A, Shenzhen B, Shanghai A, and Shanghai B

YEAR	SHENZHEN A	SHENZHEN B	SHANGHAI A	SHANGHAI B
1993	0.7767	0.0402	0.7381	0.5222
1994	0.9039	0.1277	0.9133	0.3113
1995	0.7681	0.1153	0.7951	0.3069
1996	0.2947	0.6988	0.6014	0.3891
1997	0.2401	0.4929	0.3778	0.4512
1998	0.3379	0.3959	0.2918	0.5465
1999	0.3802	0.5168	0.3671	0.5526
2000	0.3392	0.5073	0.3388	0.6735
2001	0.4573	0.7683	0.4517	0.7722
2002	0.5577	0.6574	0.5622	0.7807

The average R^2 of firm-level regressions of weekly stock returns on the market index, using the linear regression:

$$r_{it} = \alpha_i + \beta_i r_{mt} + \varepsilon_{it}$$

where r_{it} is the return of stock i in week t, and r_{mt} is the market index return.

We obtain R_{iT}^2 for each stock in each year. Then, we average the R_{iT}^2 obtained for every year T.

$$R_T^2 = \frac{\sum_i R_{iT}^2 SST_{iT}}{\sum_i SST_{iT}}$$

where SST_{iT} is the sum of squared variations in regression and is given by.

$$SST_{iT} = \sum_{t=1}^{\delta_T} (r_{it} - \bar{r}_{it})^2$$

Figure 5. R^2 Measures of Stock Prices Synchronicity of A share

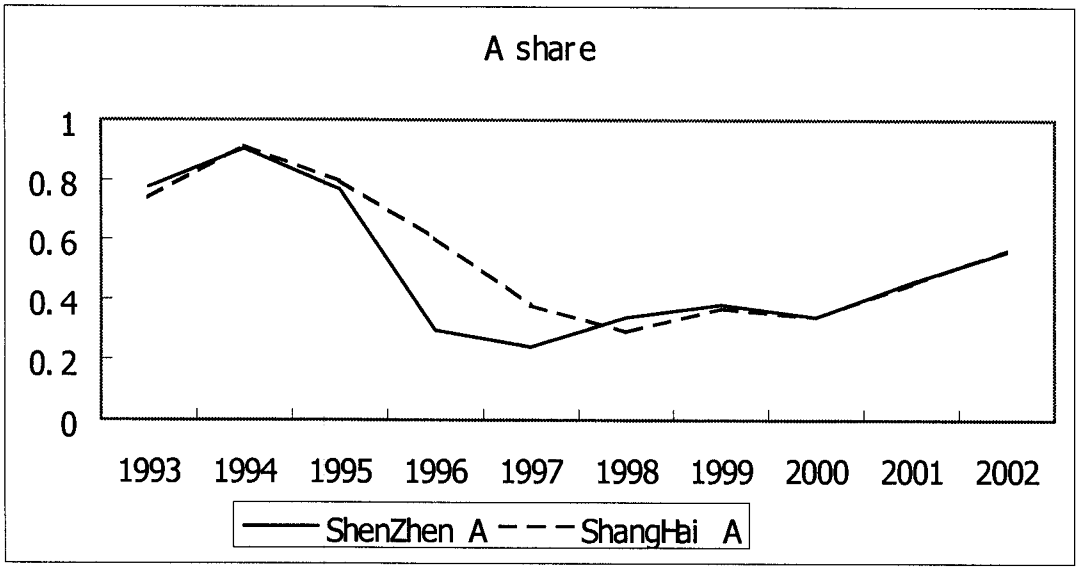


Figure 6. R^2 Measures of Stock Prices Synchronicity of B share

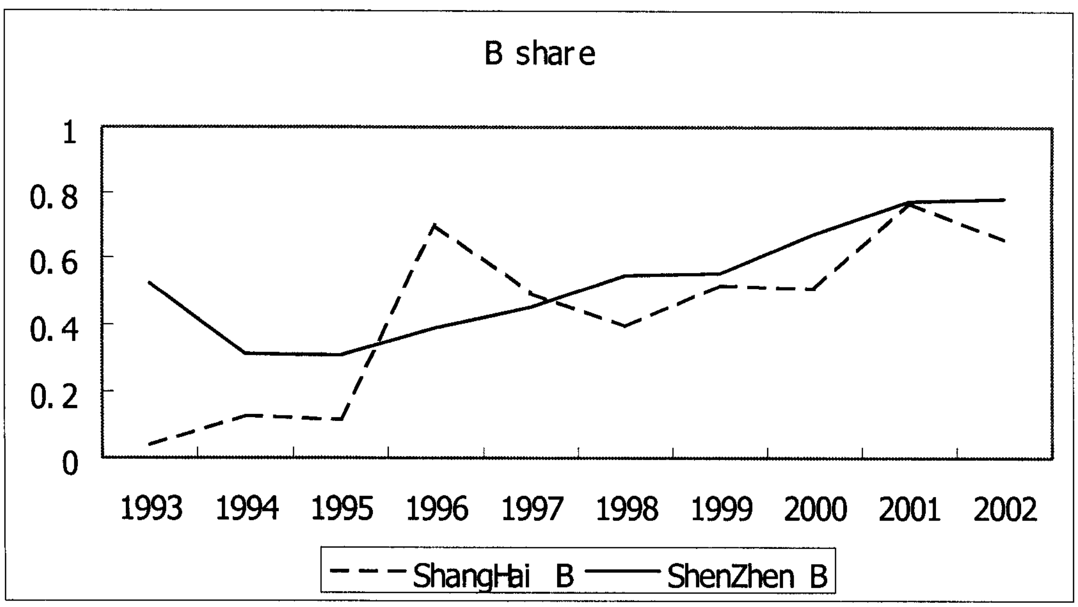


Figure 7. R^2 Measures of Stock Prices Synchronicity of ShenZhen stock market

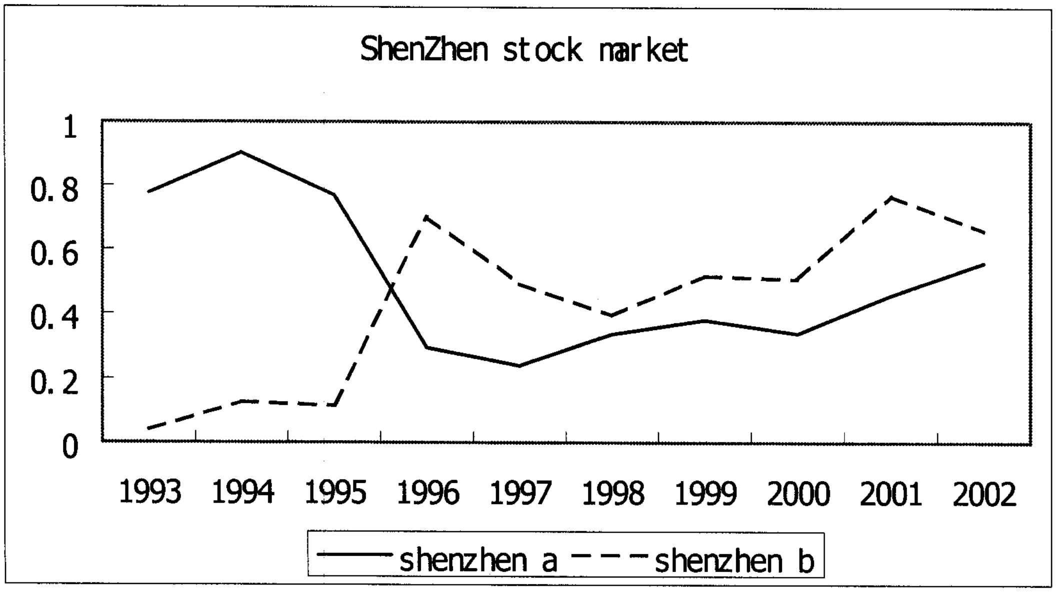


Figure 8. R^2 Measures of Stock Prices Synchronicity of ShangHai stock market

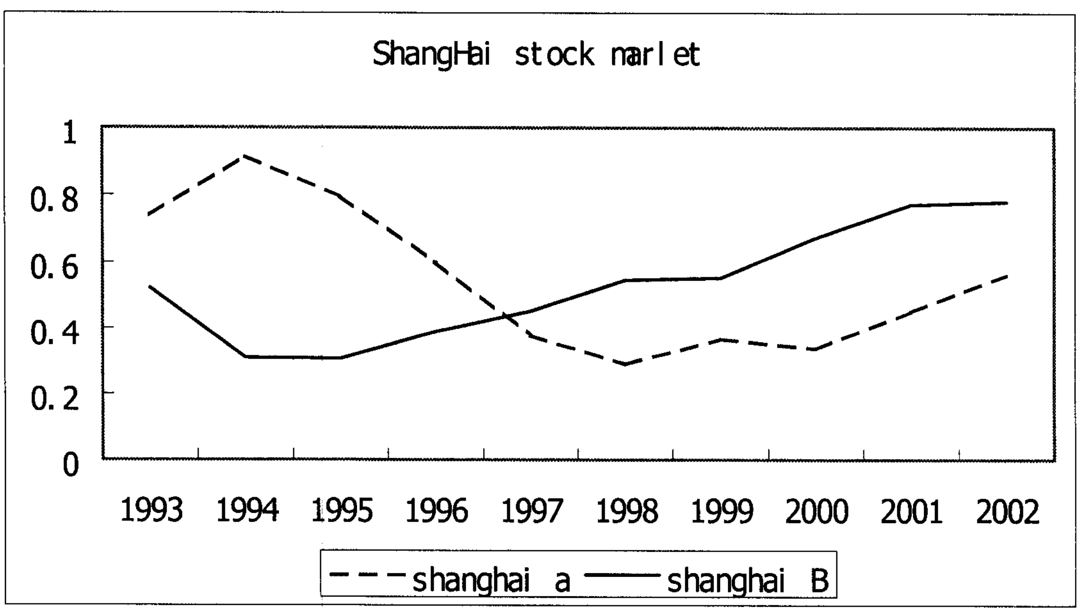


Table III. Alpha Measures of CAPM for Misspricing problems

	YEAR	ALPHA	P-VALUE		BETA	P-VALUE	
ShanghaiA	1991	-0.017737	0.4929834		0.8612175	0.0024987	**
	1992	-0.037413	0.7419849		1.4274563	5.411E-05	***
	1993	-0.009259	0.3385936		1.0553326	6.588E-11	***
	1994	0.0120565	0.2225237		1.0904367	1.049E-12	***
	1995	-0.002698	0.6834992		0.9980751	3.783E-11	***
	1996	-0.023295	0.174069		0.9302619	4.69E-06	***
	1997	-0.006348	0.5397985		1.0500633	5.709E-07	***
	1998	0.0128057	0.0171879	**	1.0834138	4.043E-10	***
	1999	-0.007469	0.1753598		0.9187618	1.339E-08	***
	2000	0.003986	0.2590583		1.0477934	2.414E-08	***
	2001	-0.002759	0.5026768		1.0321452	3.913E-09	***
	2002	-0.004781	0.4820823		1.0363307	2.62E-07	***
ShanghaiB	1993	-0.011335	0.748913		0.8949968	0.0006267	***
	1994	-0.032337	0.0166921	**	0.8086708	4.433E-08	***
	1995	-0.015013	0.1260348		0.9003486	4.961E-09	***
	1996	0.0166792	0.2501807		1.1994032	2.466E-07	***
	1997	-0.035635	0.0112435	**	0.8467474	6.284E-07	***
	1998	0.0114959	0.1255413		0.9964756	1.392E-10	***
	1999	0.0074277	0.2763559		1.0412822	2.178E-11	***
	2000	0.0119403	0.0941128		1.092751	3.05E-09	***
	2001	0.0004058	0.8979354		1.0295779	6.59E-16	***
	2002	0.0001948	0.9026869		1.0342271	4.593E-14	***

ShenzhenA	1991	0.0324007	1		1.2	1	
	1992	-0.010369	1		0.3333333	1	
	1993	0.0268039	0.5586065		1.1806963	0.0005605	***
	1994	0.0233872	0.0552372		1.1682332	3.379E-11	***
	1995	-0.011981	0.3266214		0.9957769	2.822E-08	***
	1996	0.0089533	0.8732083		0.8764629	0.0519525	
	1997	-0.001	1		1.13	1	
	1998	-0.066182	0.0138192	**	0.2353186	0.1015637	
	1999	-0.010909	0.0335361	*	0.8394462	3.964E-09	***
	2000	0.0027253	0.6155637		1.047509	4.199E-07	***
	2001	0.0030605	0.173848		1.0876698	2.066E-12	***
	2002	-0.000941	0.882803		1.0879038	4.519E-08	***
ShenzhenB	1993	-0.167899	0.7435681		-3.574851	0.1343213	
	1994	-0.071866	0.0429172	*	0.6111456	0.0024909	**
	1995	-0.090987	0.1847133		0.5072384	0.1764036	
	1996	0.0184288	0.2172327		1.1110382	2.743E-08	***
	1997	-0.009783	0.6780627		0.9237696	9.326E-05	***
	1998	-0.016497	0.4158503		0.9388915	1.244E-05	***
	1999	0.0417502	0.1902009		1.4343902	5.891E-06	***
	2000	0.002907	0.8084641		0.881846	1.185E-05	***
	2001	0.0208663	0.2008757		1.2893366	2.095E-11	***
	2002	0.0082154	0.5189098		1.3543578	5.041E-06	***

This time series cross-sectional model corresponds to the following regression:

$$E_i[r_{it}] - r_f = \alpha + \beta(r_{mt} - r_f) + \varepsilon \ , \ \ t = 1,2,\cdots,12,$$

where t represents a month, $E_i[r_{it}]$ is the monthly return of the portfolio, r_{mt} is a monthly market index return, and r_f is the free risk rate.

$E_i[r_{it}] - r_f$: The actual expected return:

$r_{mt} - r_f$: The expected return predicted by CAPM

*, **, *** denotes significant at the 10%, 5%,1% levels or better, respectively.

Figure 9. Market Alpha Measures of A share

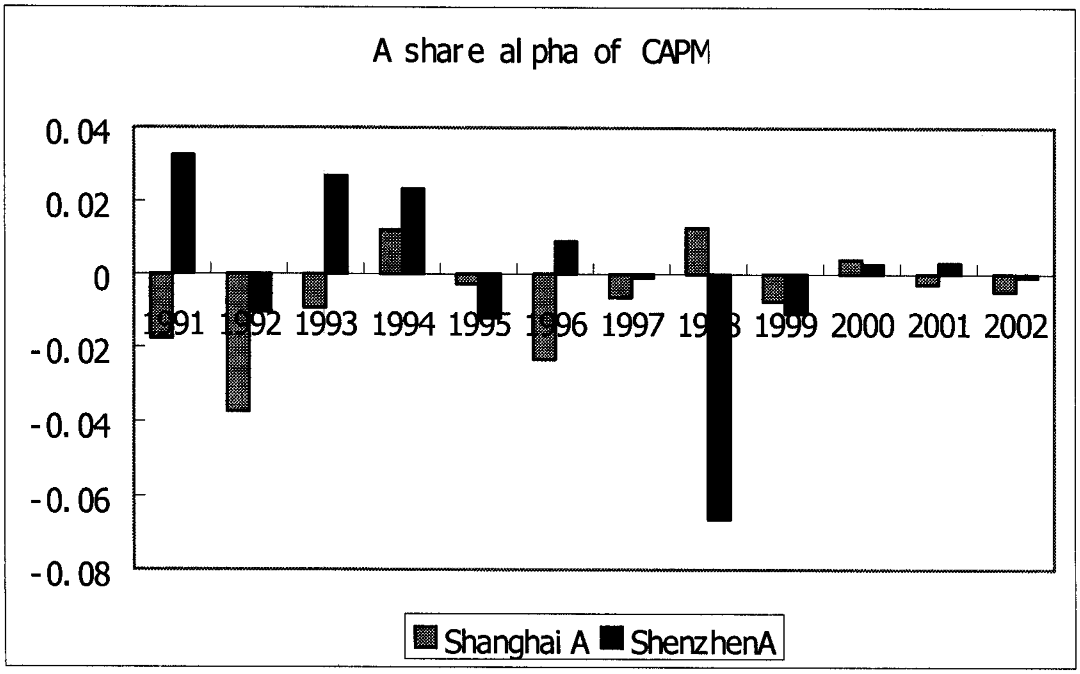


Figure 10. Market Alpha Measures of B share

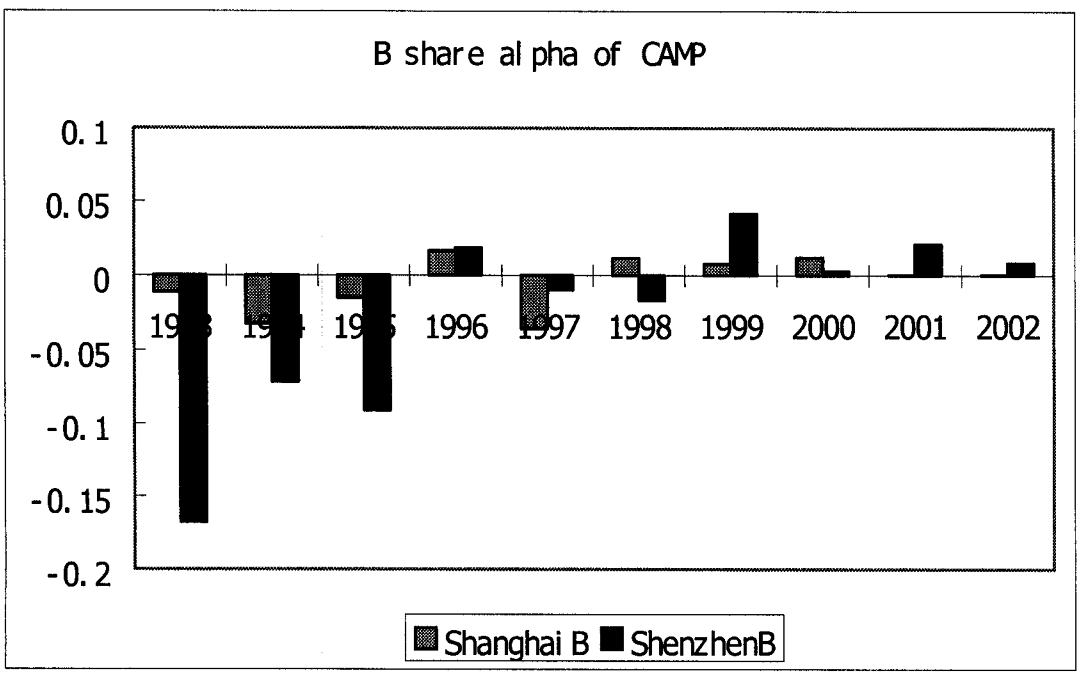


Table IV. Average alpha of CAPM

	YEAR	ALPHA	BETA	NUMBER OF FIRMS
ShanghaiA	1991	0	0	0
	1992	-0.137197	0.363915	7
	1993	-0.009751	0.998184	29
	1994	0.020363	1.135356	99
	1995	-0.004541	0.978166	156
	1996	-0.020205	0.973087	183
	1997	-0.007197	1.047316	283
	1998	0.012908	1.087895	369
	1999	-0.007656	0.918753	422
	2000	0.003716	1.057778	467
	2001	0.003151	1.025148	553
	2002	-0.005027	1.023735	621
ShenzhenA	1991	0	0	0
	1992	0	-1.56E+15	6
	1993	0.002681	1.093538	23
	1994	0.005788	1.100353	74
	1995	-0.012113	0.990871	117
	1996	-0.011518	1.092145	127
	1997	-0.043691	0.4919	223
	1998	0.01154	1.12044	345
	1999	-0.011578	0.840327	398
	2000	0.002549	1.044586	450
	2001	0.002966	1.083658	498

	2002	-0.001047	1.074392	486
ShanghaiB	1993	-0.055566	0.825448	9
	1994	-0.030625	0.83057	20
	1995	-0.013013	0.911599	31
	1996	0.015888	1.207549	34
	1997	-0.037972	0.837055	40
	1998	0.012037	0.995688	48
	1999	0.007959	1.035063	50
	2000	0.011746	1.092546	52
	2001	0.000922	1.048658	53
	2002	0.000953	1.036215	46
ShenzhenB	1993	-0.217355	-4.029225	4
	1994	-0.07197	0.615659	18
	1995	-0.082582	0.545653	21
	1996	0.024286	1.185245	32
	1997	-0.013412	0.909884	43
	1998	-0.018152	0.929028	51
	1999	0.04175	1.434389	54
	2000	0.001606	0.868407	54
	2001	0.022503	1.305591	58
	2002	0.008566	1.383347	55

This time series cross-sectional model corresponds to the following regression:

$$r_{it} - r_f = \alpha_i + \beta_i\left(r_{mt} - r_f\right) + \varepsilon,\quad t = 1,2,\cdots,12,$$

where t represents a month, r_{ir} is the monthly return of each stock, r_{mt} is a monthly market index return, and r_f is the free risk rate.

$r_{it} - r_f$: The actual expected return of each stock:

$r_{mt} - r_f$: The expected return predicted by CAPM.

Then we compute alpha by equation:

Alpha=E[α_i]

Figure 11. Average Alpha Measures of A share

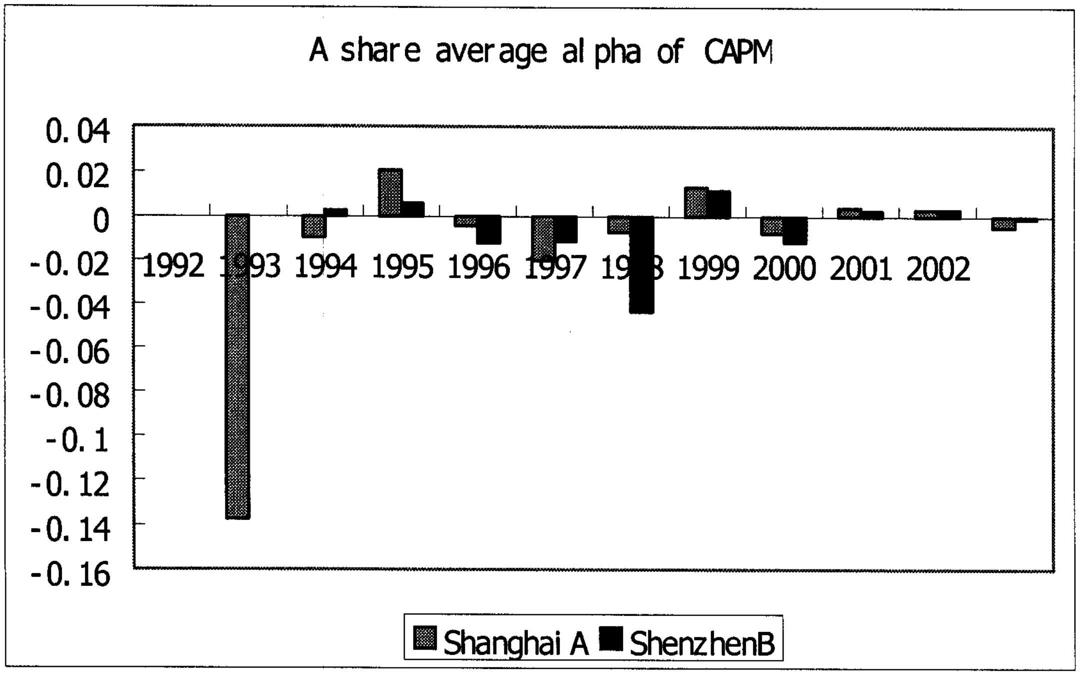


Figure 12. Average Alpha Measures of B share

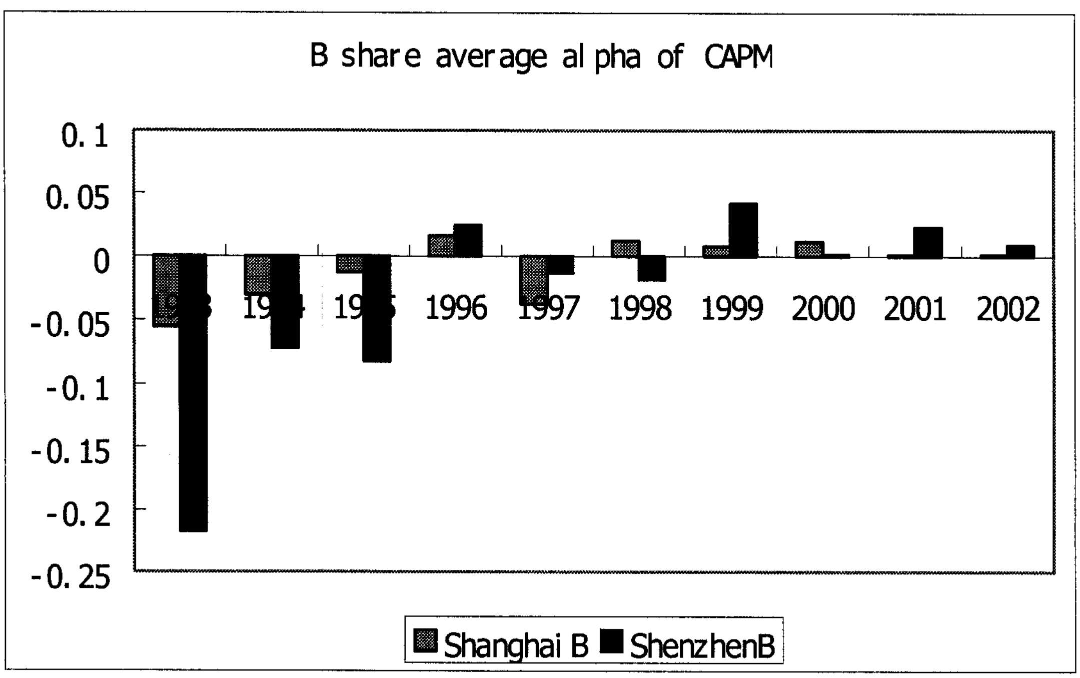


Table V. The number of listed company

YEAR	SHANGHAIA	SHANGHAIB	SHENZHENA	SHENZHENB
1991	7	0	6	0
1992	26	9	20	0
1993	95	15	60	19
1994	156	30	117	23
1995	181	34	124	32
1996	276	40	204	43
1997	367	48	343	51
1998	418	50	395	54
1999	464	52	447	54
2000	527	54	498	59
2001	625	54	501	59
2002	698	54	502	59