An Empirical Investigation of the Multi-factor and Three- factor Pricing Model in Chinese stock market

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Abstract

We propose a Multi-factor (including macro-economic variable, microeconomic variable and market variable) and a Three Factor (including intrinsic value, technical factor, and liquidity) asset pricing models, and carries on the empirical study of China's stock market. It reports that market return essentially affects on individual stock return, and β is significantly positive ranging from 0.41 to 0.53. EPS exerts the strongest positive influence on stock price, with the coefficient close to 1; while GDP growth rate, money supply, deposit interest rate, inflation rate, saving amount, and loan amount exert significant negative influence. The result demonstrates that we can effectively find out the key factors of stock pricing by the Multi-factor model, while the Three Factor Model can well price them.

Key words: Multi-factor Model, Three- factor Model, Technical factor, Liquidity

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1 Introduction

Capital Asset Pricing Model is the core of modern finance theory. It was first proposed by Sharpe (1963, 1964), and perfected by Mossin (1966) and Lintner (1965, 1969). The first test of CAPM was carried out by Lintner (1965). Miller and Scholes (1972) reinvestigated CAPM by employing the ten year data (1954-1963) of 631 stocks on New York Stock Exchange. Their results did not support CAPM. Roll (1977) made his famous criticism: there were fundamental problem while using a proxy for the market portfolio, such as Standard & Pool 500 index.

Because the CAPM model was empirically suspected, Ross (1976) advanced his Arbitrage Pricing Theory. Advocates of APT pointed out that compared with CAPM, APT had two advantages: first, it had less hypothesis limitation about investor's risk and return preference; second, it could be examined by empirical study. Roll and Ross (1980) conducted an empirical study by using the stock data that ranged from 1962 to 1972, discovering that at least three or four factors influenced the combined stock return. Chen, Roll and Ross (1986) supposed several macro-economic variables as the systematical factors that affect the market income of stock. And they proved their hypothesis.

MacKinlay (1995) carried out an empirical study and put forward a new model. He discovered that it was very difficult to prove that the deviation of CAPM was caused by lacking of risk factor; but it was easy to prove the deviation that caused by non-risk factors. Meanwhile, he also found that Multi-factor model could not explain the deviation of CAPM.

Fama and French (1992) studied the data of American stock market from 1962 to 1989, focusing on the relation of stock return and market BETA, company size, finance lever, B/M ratio, E/P ratio, cash flow, sales increase, long-term return and short-term return. They found that market BETA, finance lever and E/P ratio can hardly explain stock return, while the unity of the two factors company size and B/M ratio could nearly achieve.

After conducting an empirical study on the data of American stock market that ranged from 1963 to 1993, Fama and French (1996) put forward the famous Three Factor Model. They thought that stock return could be interpreted by the three factors including market risk premium, company size premium and B/M premium.

In recent years, the burgeoning Asian stock markets have attracted the research interest worldwide. Chui and Wei (1998) firstly verify the Fama and French Three Factor Model in Asian stock markets. They studied the relation between stock return and β coefficient, B/M, and company size in the stock markets of Hong Kong, South Korea, Malaysia, Taiwan, and Thailand. They found that the average stock return had little to do with the β coefficient, but was strongly related to B/M ratio and company size.

Drew Naughton and Veeraraghavan (2002) applied the Fama and French Three Factor Model to Shanghai A stock market. They found that B/M ratio was untenable in Shanghai A stock market, but the β coefficient and company were relevant for stock return. Risk could not well explain this phenomenon, whereas investors' irrational behaviors did.

The domestic Chinese scholars, such as Chen Langnan, Qu Wenzhou (2000), Chen Xinyuan, Zhang Tianyu, Chen Donghua (2001), Fang Longzhen, Wang Haitao (2003), Wang Chengwei, Wu Chongfeng(2003), Jia Quan, Chen Zhangwu (2003), Dan Yaowen (2004), Wu Shinong and Xu Nianxing (2004), mainly focus on the validity of the Fama and French Three Factor Model in China's stock market and other micro-factors that determine stock returns. They leave the empirical study of Multi-factor model that takes macro-factor into consideration blank. Su Dongwei, Mai yuanxun (2004) conducted an empirical study of turnover ratio and expected return. They found that asset of less liquidity had high expected return.

Some scholars have carried out empirical test on the relationship between Chinese stock market return and the macro-economic indexes. Zhao Xingqiu (1999) studied the relation between Chinese stock market return and inflation and total industrial output growth. He found that the inflation and stock return was significantly negatively correlated; the relation between total industrial output growth and stock return was not simply positively correlative; the expected output growth caused stock return to fluctuate to the opposite direction while the non-expected output growth caused stock return go to the same direction. These findings portrayed the statistical feature of the undulation of China's stock market. However, after controlling the effect of output growth, the relation of inflation and stock return disappeared, which showed that the effect of inflation on stock return came from the relationships of output and stock return, output and inflation. This just kept the same with the view of Fama. Shang Pengyue and Li Shenghong (2002) studied the cointegration relation of Shanghai and Stock Exchange index and macroscopical economic indicator. Basing on eh cointegration analysis of Multi-factor, he established a predictive model of the two by using error revise model. Its result showed that, from January 1995 to September 2000, Shanghai Stock Exchange index was sensitive to the changes of long-term interest rate, short-term interest rate and money supply, but did not have a long time balanced relation with GDP, investment in fixed assets and national price index. This has some guidance function to the study of securities market of China.

Through empirical study, Yan Yanyang, Li Zhi, Xu Junping (2004) discovered that cointegration relation existed between Shanghai and Shenzhen stock market index and some macro-economic factors; share index could reflect the whole trend and level of economy development of China to some extent, but as having weak relation with GDP, they still could not make "barometer" of economy development of China. This means that present development of Shanghai and Shenzhen stock markets is not mature enough. Stock market is interfered heavily by the noisy, non-economic factors like main banker control, administrative interference, excessive speculation and information asymmetry.

In sum, viewed from domestic and foreign scholars' studies on the CAPM, APT, the Fama and French Three Factor Model, and macro-economic factor (Chen-Roll-Ross) model, we can find that these asset pricing models take into consideration market equilibrium, the micro-economic conditions (the Fama and French Three Factor Model and multi-micro-economic variable model), and macro-economic variables (Chen-Roll-Ross model), respectively. This paper starts from analyzing the drives that cause the change of stock price, and then establishes the econometrics model of asset pricing incorporating micro-economic and macro-economic variable, conducts empirical study on China's stock market, finally draws an innovative conclusion.

The rest part of this paper is organized as follows. Part II first establishes the regression model which reflects macro-economic factor, micro-economic factor, and market factor within the APT framework. Then it carries out empirical study on verifying the factors that affect stock return, such as macro factors (e.g. time limit structure of interest rate, consumption, petroleum price, money supply and stock market policy), micro factors (e.g. book market value ratio (B/M), size effect ratio (SIZE), capital stock structure, earning per share (EPS), investment surplus stock price ratio (EP), cash flow to stock price ratio, net assets growth per share, sale proceeds growth per share), technical factors (e.g. Composite Index of Shanghai Stock Exchange and Component Index of Shenzhen Stock Exchange), and liquidity factor (e.g. the turnover rate). Part III set up the empirical regression model that portrays technical factor, inherent value and liquidity, and carries out empirical study. Finally, Part IV analyses and draws the conclusion.

2 Multi-factor Pricing Model

2.1 Construction of the Multi-factor model

(1) Micro variable

According to Marx's Political Economy theory, value determines prices, and price reflects value. Then stock price should also obey this universal law, that is, company value determines stock price, and stock price reflects company value. Therefore, some economic factors that may cause changes of company value, must influence stock price, and consequently affect stock return. Such factors include net profit growth that indicates company profit ability, company net assets growth that indicates supports the company to for a long term, sale proceeds growth that indicates company growth state and operation cash flow growth that indicates company liquidity.

According to Fama (1992), company which has high book market value ratio is of low value. He thought that such company might be at the financial predicament. Therefore, invest in such a company may face high risk, which requires high return.

The bigger the company size is, the less possible that stock price is controlled artificially, for its information will be relatively more exoteric, and the stock price fluctuating range will be relatively smaller. As small size companies face more uncertainty of business performance, it will face higher risk while buying their stock. High risk requires high repayment, so it will have more profit in buying stocks of small size company. Current stock rate is one of the tokens of company size.

(2) Liquidity

Theoretically, sock market has the phenomenon of liquidity premium. If the liquidity of the sock is low, the more its transaction cost is, the higher prospective earnings for the investors are. Amihud and Mendelson (1986, hereafter called AM) thought that, under the balanced state, there exists clientele effect in the securities market which using method of promoting exchange by pricing, namely investors will choose voluntarily to invest in those stocks that have less liquidity rate but more transaction cost; liquidity can be measured by relative buy and sell price margin (buy and sell price margin divide buy and sell intermediate price); the expected stock return is a segmental liner and holistic concave increasing function of its relative buy and sell price margin. That is to say, liquidity and stock return are subtractive correlated. Here I use turnover rate as the measurement of stock liquidity.

(3) Macro factors

Chen, Roll and Ross (1986) used market index, industrial output growth rate, expected inflation rate, unexpected inflation rate, margin of long/short term government bond and monthly stock return as the regression of time sequence. They found that market index has very weak explanation on stock return; industrial output growth rate, but unexpected inflation rate has significant explanation on stock return. Industrial output growth rate presents the growth of company total value, and stock price should respond accordingly. Inflation shows unbalanced change of money supply and demand. Inflation then in fact makes the actual non-risk interest rate lower than nominal non-risk interest rate. The decline of interest rate will increase the demand for the speculative motivation of currency, and then cause the rise of stock price.

Under the condition that people are reasonable, they will evade risk when investing. In China, securities mainly include government bond and stock. Which one people will invest in is determined by their anticipation of its yield and risk, and by their ability of bearing the risk. The margin of long-term government bond yield and the previous interest rate is considered to be the measurement of unexpected yield of government bond. I continue Chan's research (1986) and use the margin of long-term government bond yield and the previous interest rate as the measurement of weighing people's changing status of evading risk. When people are more afraid of risk, instead of invest in high risk stock, they will turn to long-term government bond, which will cause the rise of it. I predict that this index and stock return are subtractive correlated.

The increase in investment of the fixed assets reflects the change of a company's ability of long-term growth, thus, influence the stock price.

According to the CAPM model, per share yield is liner correlated with market investment combination income, which is the effect that market index has on assets pricing. I use Shanghai (Shenzhen) annual yield of composite index to explain per share yield, and verify the applicability of CAPM model in China's stock market.

Constructing the following empirical model according to APT:

$$R_{it} = \alpha + \beta_1 \Delta EPS_{it} + \beta_2 \Delta BVPS_{it} + \beta_3 \Delta SPS_{it} + \beta_4 BDM_{it} + \beta_5 SIZE_{it} + \beta_6 TURNOVER_{it} + \beta_7 OUTSHARE_{it} + \beta_8 ROINDEX_t + \beta_9 \Delta GDP_t + \beta_{10} \Delta FI_t + \beta_{11} \Delta IP_t + \beta_{12} GB_t + \beta_{13} I_t + \varepsilon_{it} \tag{1}$$

Variable definition and explanation

Variable	Variable Explanation	Calculating Method
R_{it}	Per share return rate	(1) Annual per share return accumulation (accumulation of monthly return within the year) (2) The margin of the comparable price of rights offerings and pay stock dividends of the early and later period of a year divides comparable stock price of the early period of the year. $\frac{P_{it}(1+F_{it}+S_{it})*C_{it}+D_{it}-P_{i,t-1}-S_{it}*K_{it}*C_{it}}{P_{i,t-1}+S_{it}*K_{it}*C_{it}}$
ΔEPS_{it}	Earning per share (EPS) growth	$\frac{EPS_{it}-EPS_{i,t-1}}{EPS_{i,t-1}}$
$\Delta BVPS_{it}$	Growth of net assets per share	$\frac{BVPS_{it}-BVPS_{i,t-1}}{BVPS_{i,t-1}}$
ΔSPS_{it}	Sale proceeds growth of per share	$\frac{SPS_{it}-SPS_{i,t-1}}{SPS_{i,t-1}}$

BDM_{it}	Book market value ratio	$\frac{BV_{i,t-1}}{MV_{i,t-1}}$
$SIZE_{it}$	Company size	IN (total market value) or IN (current market value)
$TURNOVER_{it}$	Turnover rate	The number of transacted annual per share divides the number of current stock (mean value)
$OUTSHARE_{it}$	Current stock rate	Annual proportion mean value of current stock of the early and later period in the year
$ROINDEX_t$	Index return rate	$\frac{INDEX_t - INDEX_{t-1}}{INDEX_{t-1}}$
ΔGDP_t	GDP growth	$\frac{GDP_t - GDP_{t-1}}{GDP_{t-1}}$
ΔFI_t	Fixed assets investment growth	$\frac{FI_t - FI_{t-1}}{FI_{t-1}}$
ΔIP_t	Industrial output growth	$\frac{IP_t - IP_{t-1}}{IP_{t-1}}$
GB_t	Time limit structure of the interest rate	$LGB_t - TB_{t-1}$
I_t	Inflation rate	$CPI_t - CPI_{t-1}$

2.2 Result of empirical study

I developed a panel dataset based on all listed companies' financial indicators and macroeconomic indicators ranging from 1991 to 2003. Both stock return and the elucidative variables are of annual frequency.

Table 1 shows the descriptive statistics of the empirical analysis, from which we can find that from 1991 to 2003, the average yield of market index is 8.8%, and the standard deviation is 36. 68%; the annual turnover rate is 400, much higher than the mature market (60%).

Table 2 shows the result of stock return and listed company's turnover rate, market return rate, and the β coefficient and the t value of the Multi-factor liner regression equation (1). Table 1 shows: 1. no matter how many elucidative variables there are in the regression equation, the coefficient of market index return rate is significantly positive, and the changing range of the coefficient lies in 0.41 to 0.53, which means that the explanation ability of market index towards stock return reaches between 41% and 53%, and averages 50%. Namely, when annual market index increases 1%, annual stock will increase 0.5% on average. 2. No matter how many elucidative variables there are in the regression equation, the estimated coefficient of EPS growth is positive, and approaching to 1, which indicates that EPS growth has positive effect on stock return, that is to say, when EPS increases 1%, annul stock return will increase 1% on average. 3. Per share net assets also has explanation ability on stock return. However, no matter how many elucidative variables there are in the regression equation, its estimative coefficient close to 0.2, shows that per share net assets growth has weaker explanation ability than EPS growth towards stock return, that is, stock price has stronger response on listed company's expected EPS growth than on its expected assets growth. 4. For the explanative variable turnover rate, no matter how the estimate model changes, the estimate value of its parameter coefficient approaches to 0.07, and it is significantly positive, showing that the higher turnover rate is, the higher stock return will be. Therefore, the liquidity factor that represented by turnover rate affects assets pricing, and there exists significant positive liquidity premiums in the stock market of China. This result is not in accordance with that of Su Dongwei and his fellows' (2004). 5. Book market value ratio also has strong explanation power, and its coefficient is significantly positive, which means that, high value company relatively has high stock price in the stock market of China. This keeps the same with domestic and international research results. 6. Real estate price growth has obvious strong explanation ability on stock return, and its coefficient is significantly positive, which means that the changes of stock price and that of real estate are going the opposite way. This result shows us the evidence that investors of China conduct stock jobbing arbitrage in stock and real estate market. 7. For Macro-economic variables, like GDP growth, money supply growth, deposit interest rate growth, inflation rate, deposit growth, loan growth, etc., the estimated coefficient is significantly negative, indicating that stock return is a decrease function of macro-economic variables of China. This is inconsistent with the research of Chen, Roll and Ross (1986). The stock market can not be the barometer of macro-economy in China. However, the conclusion of this research is consistent with Shun Huahao and his fellows' (2003) discovery stock market has significant negative effect of GDP. But the conclusion about the effect of monetary policy on stock price is not the same as that of Shun Huahao and his fellows' that monetary quantity is inoperative towards stock price.

Table 1 descriptive statistics of the empirical analysis

	Mean	Median	Max	Min	Standard Deviation
Earning per share (EPS) growth（△eps）	-0.0033	-0.0020	1.1984	-0.6555	0.0497
Net assets growth of per share（△E）	-0.0062	0.0038	1.5673	-1.2729	0.0744
Book market value ratio（BM）	0.2800	0.2540	1.4818	-1.4401	0.1659
Turnover rate (turnover)	4.0026	3.2421	31.8510	0.1242	2.9345
Market index return (RM)	0.0881	-0.0261	1.8905	-0.4098	0.3668
Money supply growth (△M1)	0.1715	0.1767	0.3878	0.1185	0.0380
Deposit interest rate growth (△r)	-0.1457	-0.1000	0.2242	-0.4000	0.1502
Real estate price growth (△H)	0.0283	0.0365	0.2013	-0.1501	0.0383
Inflation rate (I)	0.0194	0.0039	0.2409	-0.0141	0.0531
GDP growth (△GDP)	0.0847	0.0830	0.1424	0.0714	0.0120
Savings growth (△D)	0.1896	0.1901	0.3671	0.1367	0.0542
Loan growth (△L)	0.1564	0.1690	0.2644	0.0601	0.0593

Table 2

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Constant items	-0.14***	-0.31***	-0.20***	-0.25***	0.04	-0.05***	-0.05***
	(-8.07)	(-31.51)	(-19.95)	(-26.16)	(1.49)	(-3.87)	(-4.30)
Earning per share (EPS) growth	1.01***	0.97***	0.98***	0.97***	1.00***	1.01***	1.06***
（△eps）	(11.84)	(11.73)	(11.55)	(11.42)	(11.88)	(12.19)	(13.02)
Net assets growth per share	0.18***	0.23***	0.19***	0.19***	0.20***	0.19***	0.18***
（△E）	(3.23)	(4.23)	(3.34)	(3.45)	(3.52)	(3.38)	(3.27)
Book market value ratio	0.17***	0.21***	0.14***	0.19***	0.22***	0.30***	0.35***
（BM）	(7.05)	(8.96)	(6.05)	(7.85)	(8.93)	(12.12)	(14.41)
Turnover rate	0.07***	0.06***	0.06***	0.07***	0.07***	0.07***	0.07***

(turnover)	(42.20)	(43.54)	(39.30)	(40.12)	(43.64)	(46.34)	(48.08)
Market index return	0.53***	0.44***	0.55***	0.50***	0.50***	0.46***	0.41***
(Rm)	(42.96)	(34.12)	(42.26)	(39.12)	(40.28)	(36.34)	(32.79)
money supply growth	-0.57***						
(△M1)	(-5.58)						
deposit interest rate growth		-0.48***					
(△r)		(-18.44)					
Real estate price growth			-0.59***				
(△H)			(-5.76)				
Inflation rate				-0.48***			
(I)				(-6.04)			
GDP growth					-3.60***		
(△GDP)					(-10.91)		
Savings growth						-1.31***	
(△D)						(-17.57)	
Loan growth							-1.63***
(△L)							(-24.86)
Adj_R2	0.55	0.57	0.55	0.55	0.56	0.57	0.59
D_W	1.94	1.95	1.95	1.94	1.94	1.93	1.94

Note: *** means 1% significance

3 Three Factor Pricing Model and the empirical study

3.1 Three Factor Pricing Model and its construction method of security price

In the aforementioned research of Multi-factor model, we can find that company micro-economic variable that reflects its inherent value, market index yield that reflects market emotion and turnover rate that reflects liquidity all have significant impact on stock return. In order to portray the effects that technical factor, inherent value and liquidity have on stock return, this paper takes APT Multi-factor model as the theoretical foundation, and establishes an econometrics regression model that reflects technical factor, inherent value and liquidity:

$$R_{it} = \alpha + \beta_{IV} IV_{it} + \beta_{TF} TF_{it} + \beta_{TO} TO_{it} + e_{it}$$
$$r \to 0 \qquad t$$

In this expression, R_{it} is the yield of stock i in t ; i =1, 2, 3, …, n; IV_{it} is the factor that reflects stock inherent value; β_{IV} is the sensitiveness coefficient of inherent value factor; TF_{it} is the technical factor; β_{TF} is the sensitiveness coefficient of stock return to technical factor; TO_{it} is the liquidity factor; β_{TO} is the sensitiveness coefficient of stock return to liquidity factor. IV_{it} and TF_{it} are determined by using main component analysis method.

Main component analyses a kind of statistics analysis method that translate many variables into several integrated indexes. Mathematically, this is a reducing dimension technique. Supposing that there are n samples, and each has k descriptive variables, then they will form an n*k ranks datum matrix as followed:

$$X = \begin{bmatrix} X_{11} & X_{12} & \cdots & X_{1k} \\ X_{21} & X_{22} & \cdots & X_{2k} \\ \cdots & \cdots & \cdots & \cdots \\ X_{n1} & X_{n2} & \cdots & X_{nk} \end{bmatrix} \tag{1}$$

How to find out the inherent regularity from the data of so many variables? To solve this problem, we should analyse it from k dimensions naturally, but it would be troublesome. For overcoming this difficulty, we need to reduce the dimensions, that is to say, translate many variables into several integrated indexes, which are independent from each other and contain as much information as they can of those original variables. Then how to choose these indexes? Obviously, the simplest way is to choose the liner combination of the original variables, and adjust the combination coefficient properly to make sure that the new variables are irrelative and representative.

If the original variables are x_1 , x_2 , … , x_p , and their combination coefficient—the new variables are z_1 , z_2 , … , z_m ($m \le p$). That is:

$$\begin{cases} z_1 = l_{11}x_1 + l_{12}x_2 + \cdots + l_{1k}x_k \\ z_2 = l_{21}x_1 + l_{22}x_2 + \cdots + l_{2k}x_k \\ \cdots \\ z_m = l_{m1}x_1 + l_{m2}x_2 + \cdots + l_{mk}x_k \end{cases} \tag{2}$$

In the expression (2), coefficients l_{ij} are determined according to the following rules:

i z_i and z_j ($i \neq j$; i , j =1 , 2 , … , m) are irrelative ;

ii z_1 is the maximum of mean variance of all combinations of x_1 , x_2 , … , x_p ; z_2 is the maximum of mean variance of all combinations of x_1 , x_2 , … , x_p that is irrelative with z_1 ; …… ; z_m is the maximum of mean variance of all combinations of x_1 , x_2 , … , x_p that is irrelative with z_1 , z_2 , …. , z_m .

z_1 , z_2 , … , z_m that determined in this way are the first, second, …, m main component of x_1 , x_2 , … , x_k . Among them, the total value variance z_1 is biggest one, and z_2 , z_3 , … , z_m are descending orderly. In practice, we usually choose several biggest main components only. Because it can reduce the amount of variables, focus on main issues and simplify the relation between the variables.

From the analysis above, we can see that process of determining main component is that of determining the coefficients l_{ij} of the original variables that relate to main components z_i (i =1 , 2 , … , m). Mathematically, we know that they are eigenvectors of the biggish eigenvalue of x_1 , x_2 , … , x_p .

After introducing the basic principle of main component analysis, we can conclude the calculation procedure as followed:

1. Calculate the matrix of the correlative coefficient

$$R=\begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1k} \\ r_{21} & r_{22} & \cdots & r_{2k} \\ \cdots & \cdots & \cdots & \cdots \\ r_{n1} & r_{n2} & \cdots & r_{nk} \end{bmatrix} \tag{3}$$

In expression (3), r_{ij} (i , j =1, 2, …, k) are the correlative coefficients of x_i and x_j or original variable.

2. Calculate the eigenvalue and the eigenvector

First, calculate the eigen-equation $|\lambda I - R|=0$ and get the eigenvalue λ_i (i =1, 2, …, k), and arrange them in a big-to-small order, namely $\lambda_1 \geq \lambda_2, \cdots, \geq \lambda_k \geq 0$. Second, calculate the eigenvector e_i (i =1, 2, …, k) of λ_i.

3. Calculate the contribution rate of the main component and accumulative contribution rate

The contribution rate of main component z_i is $\lambda_i \Big/ \sum_{d=1}^{k} \lambda_d$, and the accumulative contribution rate is $\sum_{d=1}^{l} \lambda_d \Big/ \sum_{d=1}^{k} \lambda_d$. Generally, we choose the eigenvalue λ_1 , λ_2 , …, λ_m , whose accumulative contribution rate lies between 85% and 95%, as the first, second, …, m main component.

4. Calculate the load of the main component

The load of the main component is the correlative coefficient of main component and original index. Then we can calculate the main component score:

$$Z=\begin{bmatrix} z_{11} & z_{12} & \cdots & z_{1m} \\ z_{21} & z_{22} & \cdots & z_{2m} \\ \cdots & \cdots & \cdots & \cdots \\ z_{n1} & z_{n2} & \cdots & z_{nm} \end{bmatrix}$$

3.2 Empirical analysis

3.2.1 Sample and source

This paper uses 8414 records data that about all listed companies' annual financial status and business deal that ranges from 1991 to 2003. When calculating the growth index, we could not get the growth index of the data of company's coming into the market in the first year. Therefore, we eliminated 1347 records data that did not have entire sample, and got 7067 samples for the main component analysis and regression analysis. The annual macroscopical index corresponds with the indexes of annual financial status and business deal of every listed company, forming the mixed panel data. Data of annual financial status and business deal came from the CCER database, and the macroscopical data came from China macro-economy information center (http://www.macrochina.com.cn).

3.2.2 Main component analysis

I use SPSS statistics software to carry out main component analysis on five inherent value variables that affect stock return, and get the eigenvalues and contribution rate, as showed in Table 1.

Because this research has no requirement on the accumulative contribution rate of main component, we only choose those main components whose eigenvalues are more than 1 for the further analysis, and get the main component load matrix and score coefficient matrix, as showed in table 2.

In table 2, the moderate mensuration value of KMO sample is 0.599, which is more that 0.5, so it can be used for main component analysis. From the main component load matrix, we can see that the positive and negative marks of the five loads accord with the foresaid theory of this paper; the loads of variable X1 and X2 are the biggest two, which are exactly what inherent values of the company lies in. Therefore, I think that the main component Z1 can be interpreted as the inherent value factor that affecting stock return.

Hence, the inherent value factor Z2 that affecting stock return can be expressed as the following liner combination:

Z2=0.798*X1+0.382*X2+0.425*X3+0.831*X4+0.277*X5 （4）

Equally, I use SPSS statistics software to conduct main component analysis on eight technical variables that affect stock return, and get the eigenvalues and contribution rate, as showed in Table 3.

I choose those main components, whose eigenvalue are more than 1, and get the main component load matrix and score coefficient matrix, as showed in table 4.

In table 4, the moderate mensuration value of KMO sample is 0.599, which is more that 0.5, so it can be used for main component analysis. From the main component load matrix, we can see that the positive and negative mark of each load accord with the foresaid theory of this paper; the load of variable X4 is 0.93, and that of X8 is 0.5. Therefore, I think that the main component Z3 can be interpreted as the technical factor that affecting stock return.

So, the technical factor Z3 that affecting stock return can be expressed as the following liner combination:

Z3=0.08 *X1+0.08* X2+0.16* X3+0.93* X4-0.02* X5-0.25* X6+0.23* X7-0.50* X8 （5）

3.2.3 Three Factor regression analysis

By the calculation of expression (4) and (5), we can get corresponding inherent value factor array IV_{it} and technical factor array TF_{it}. Then, with liquidity factor array, they form the tri-factor that explain stock return together. The relevant liner regression result is in table 5.

Viewing from the examining value of regression coefficient T, we can see that the three factors, including inherent value factor, technical factor and liquidity factor, all have significant explanation ability on stock return. From the magnitude of the standardized coefficients, we can see that in the China's stock market, technical factor has the greatest effect on stock return, then followed by liquidity factor, and finally inherent value factor.

Table 1 Eigenvalues and contribution rate of main components

Main component	Eigenvalue	Contribution rate (%)	Accumulative contribution rate (%)
Z1	2.04	40.81	40.81
Z2	1.10	21.90	62.71
Z3	0.88	17.59	80.30
Z4	0.58	11.62	91.92
Z5	0.40	8.08	100.00

Table 2

	Main component load matrix		Main component score coefficient matrix	
	Z1	Z2	Z1	Z2
Increase in per share profit of the main business (X1)	0.798	0.19	0.464	-0.011
Earning per share (EPS) growth (X2)	0.382	0.713	0.099	0.476
Net assets growth per share (X3)	0.425	0.577	0.153	0.362
Sale proceeds growth per share (X4)	0.831	-0.028	0.528	-0.187
Book market value ratio (X5)	0.277	-0.727	0.319	-0.618
KMO	0.599			

Table 3

Main component	Eigenvalue	Contribution rate (%)	Accumulative contribution rate (%)
Z1	4.35	54.41	54.41
Z2	1.57	19.57	73.98
Z3	1.04	12.95	86.93
Z4	0.51	6.32	93.26
Z5	0.38	4.74	97.99
Z6	0.10	1.20	99.19
Z7	0.05	0.60	99.79
Z8	0.02	0.21	100.00

Table 4

	Main component load matrix			Main component score coefficient matrix		
	Z1	Z2	Z3	Z1	Z2	Z3
GDP growth (X1)	0.97	-0.08	0.08	0.233	0.007	0.093
Inflation rate (X2)	0.83	-0.51	0.08	0.163	-0.336	0.163
Real estate price growth (X3)	-0.01	0.97	0.16	0.078	0.713	-0.026
Market index return (X4)	0.07	0.12	0.93	0.044	-0.056	0.751
Savings growth (X5)	0.92	-0.30	-0.02	0.201	-0.152	0.05
Loan growth (X6)	0.83	0.20	-0.25	0.214	0.262	-0.223
Money supply growth (X7)	0.78	0.25	0.23	0.217	0.212	0.164
Deposit interest rate growth (X8)	0.70	-0.11	-0.50	0.152	0.054	-0.38
KMO	0.599					

Table 5 Regression coefficient and examination of Three Factor Model

	Non-standardized coefficient	Standardized coefficient	T value
Constants	-0.09***		-12.76
Inherent value factor IV_{it}	0.057***	0.123	16.013
Technical Factor TF_{it}	0.247***	0.504	53.573
Liquidity factor TO_{it}	0.054***	0.344	36.602
Adj_R2	0.582	D-W	1.961

Note: *** 1% significance

4 Conclusion

To get the inherent law of stock pricing behavior scientifically and to propose pricing model of securities correctly are the pressing issues that require research and solution both in theory and practice. This paper have proposed the Multi-factor model that describes securities behavior, and the tri-factor econometrics model that reflects the inherent value factor, technical factor and liquidity factor of stock. In the empirical study of Multi-factor, we can see that: (1) liquidity has significant positive liquidity premiums in the stock market of China; (2) the coefficient of market index return is significantly positive, and the changing range of the coefficient lies in 0.41 to 0.53, which means that the explanation ability of market index towards stock return is 41% to 53%, and averages 50%; (3) EPS growth has greatest effect on stock price. The estimated coefficient of EPS growth is significantly positive, closing to 1, which means that increase of EPS has positive influence on stock return, namely the surplus per share increases 1%, the annual prospective earnings will increase 1% equally; (4) the estimated coefficients of GDP growth, money supply, deposit interest rate, inflation rate, saving amount and loan amount are negative, which indicates that stock return is a decrease function of the macro-economic variables in China; (5) Real estate price growth has obvious strong explanation ability on stock return, and its coefficient is significantly negative, which means that the changes of stock price and that of real estate are going the opposite way. This result shows us the evidence that investors of China conduct stockjobbing arbitrage in stock and real estate market; (6) in the empirical study of tri-factor, we made empirical study on China's securities market by using main component analysis method, and got the pricing model that reflects inherent value factor, technical factor and liquidity factor of Chinese stock for the first time. From this model, we can see that the three factors, including inherent value factor, technical factor and liquidity factor, all have significant explanation ability on stock return. From the magnitude of the standardized coefficients, we can see that in the China's stock market, technical factor has the greatest effect on stock return, then followed by liquidity factor, and finally inherent value factor.

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