Pricing International Risk Factors: The Shanghai Stock Market in the 1990s

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1. Introduction

Stock markets are not new to China. In Shanghai, the history of the organized exchange dates back to about 1914. The Shanghai stock exchange (SSE) itself was established in 1920 and thus, the closure of the exchange under the Peoples Republic can be seen as a temporary break. The Shanghai stock exchange re-opened on December 19, 1990 with only eight listed firms but witnessed rapid growth over the following 10 years. On July 3, 1991 the Shenzhen exchange opened and by May 1992 all price limits were removed (Shanghai Stock Exchange, 1995).

Firms could list their shares on either the A or B share market.(1) A class shares, quoted in RMB yuan, were owned and traded by Chinese nationals. B shares, on the other hand, were bought and sold in US dollars (quoted in RMB yuan) and were open to investment by foreign nationals. B shares became available for trading on the Shanghai and Shenzhen exchanges in February 1992 and December 1991 respectively. By the end of 1996 there were 287 firms listed as A shares and 42 firms listed as B shares on the SSE. 227 firms listed A shares and 43 as B shares in Shenzhen. In December 1997, the Shanghai stock exchange moved to its new home in Pudong with some 400 firms listed on the exchange.

A and B shares for the same firm are identical in terms of voting rights and dividends.(2) We expect to see the shares for the same firm to trade at equivalent (or approximately) prices. However, we find that B shares trade at a substantial discount to A shares, on average, during the 1990s. Most international evidence suggests the reverse

phenomena: shares open to investment by international investors trade at a premium over the domestically traded shares. Yet the B shares listed on the Shanghai exchange trade at a 65.2% discount (daily data) (23 paired firms) and the Shenzhen B shares (16 paired firms) trade at a 48.7% discount during the mid-1990s (Chakravarty, Sarkar, Wu, 1999).

The Shanghai stock exchange (SSE) gives us an opportunity to test the effect of exchange risk on a set of shares which are identical but are open to mutually exclusive groups of investors. This paper examines whether exchange risk is recognized in both the SSE B and corresponding A shares within the framework of the arbitrage pricing theory (APT) .(3) If the risk factor is not priced in the stock market, then exposure to that risk factor gives rise to increased risk without any additional compensating return. On the other hand, if the factor is priced in equilibrium, then we could expect additional return when exposure to the risk factor increases.

Bailey (1994) provides a preliminary analysis on the B share market in both the Shenzhen and Shanghai markets using weekly data from March 1992 to March 1993. He studies two SSE B shares and several Shenzhen shares, and finds the two SSE B shares are correlated with the Hang Seng index for Hong Kong but not with the EAFE or SP500 index. Bailey (1994) also provides evidence that lagged U.S financial indicators and lagged Hang Seng index returns are associated with the returns of the two Shanghai B shares. In a related study Bailey and Jagtiani (1994) look at the Thai stock market and focus on the premium of alien board over main board stock prices. The premium can be explained by the difference in exposure coefficients for the exchange risk factor and world market risk factors.

2. The Model

We assume a four-factor generating model where the ith stock return is a linear function of the exchange risk factor, fx_t and the domestic market risk factor, rm_t, oil price factor, oil_t, and world market risk, rw_t.

$$R_{it} = \beta_0 + \beta_{rm,i} rm_t + \beta_{oil,i} oil_t + \beta_{fx,i} fx_t + \beta_{rw,i} rw_t + v_{it} \quad (1)$$

where the coefficients $\beta_{rm,i}$, $\beta_{oil,i}$, $\beta_{fx,i}$, and $\beta_{rw,i}$ are the domestic market risk, oil price factor risk, foreign exchange risk and world market risk exposure coefficients for firm i, respectively, and v_{it} the error term.

We assume a four factor APT model so that the expected stock return for company i at time t, $E_t(R_{it})$, takes the form

$$E_t(R_{it}) = \lambda_0 + \lambda_{rm}\beta_{rm,i} + \lambda_{oil}\beta_{oil,i} + \lambda_{fx}\beta_{fx,i} + \lambda_{rw}\beta_{rw,i} \quad (2)$$

where λ_0 is the rate of return on a zero beta portfolio, λ_{rm} is the premium on the domestic market risk, λ_{oil} is the premium on the oil price risk, λ_{fx} is the premium on the exchange risk, and λ_{rw} is the premium on the world market risk. Since $E_t(rm_t) = \lambda_0 + \lambda_{rm}$, then we can rewrite (2) to get

$$E_t(R_{it}) = \lambda_0 + \lambda_{oil}\beta_{oil,i} + \lambda_{rw}\beta_{rw,i} + \lambda_{fx}\beta_{fx,i} + [E_t(rm_t) - \lambda_0]\beta_{rm,i} \quad (3)$$

Taking expectations of (1) and subtracting (1) from it gives us

$$R_{it} = E_t(R_{it}) + \beta_{oil,i} oil_t + \beta_{rw,i} rw_t + \beta_{fx,i} fx_t + \beta_{rm,i}[rm_t - E_t(rm_t)] + v_{it} \quad (4)$$

Next substitute (3) into (4) to yield

$$R_{it} = [\lambda_0(1-\beta_{rm,i}) + \lambda_{oil}\beta_{oil,i} + \lambda_{fx,i}\beta_{fx,i} + \lambda_{rw}\beta_{rw,i}] + \beta_{oil,i} oil_t + \beta_{fx,i} fx_t + \beta_{rw,i} rw_t + v_{it} \quad (5)$$

which is the equation we use to obtain estimates of the risk premiums. The iterated non-linear seemingly unrelated procedure is applied to the system to estimate the risk premia and the exposure coefficients simultaneously as discussed in Gibbons (1982) and Burmeister and McElroy (1988).

3. Empirical Results

We use monthly data for thirteen A and corresponding B stocks listed on the Shanghai stock exchange from August 1993 to November 1995. Closing prices on the

last trading day of the month are employed.(4) The data set is limited to the thirteen companies which list both A and B shares on the SSE and for which we could obtain at least two years of monthly data. Furthermore our study is limited to an unconditional asset pricing model due to such data limitations. The domestic market risk factor is the log relative return on the Shanghai composite stock index, the world risk factor is the log relative return in the Solomon Brothers world index, the exchange rate is measured as the log relative change in the J. P. Morgan trade weighted US dollar rate, and we take the log relative change in the international oil price to be the oil price risk factor.

Exposure coefficient estimates are presented in Table 1. For both the world market and exchange risk factors only 3 out 13 of the exposure coefficients are statistically significant in the case of A shares. All world market and exchange exposure coefficients are not statistically significant for the B shares. This could be due to a lack of data since we only cover a little more than two years. The effect of exchange risk could be lagged and thus not appear in the model we estimate in this paper (Bartov and Bodnar, 1994).

The focus of this paper is on the pricing of international risk factors and thus the λ_i coefficient for each risk factor i. We find that the exchange factor is statistically significant for the A share model but not significant for the B share model (Table 2). In the case of B shares, we find the world market risk factor to be priced in the sense that it is statistically different from zero (Table 2). Thus we provide evidence suggesting that both the A and B share markets are associated with international risk factors. This is an intuitively appealing result in the case of B shares since they are open to investment from abroad. The A share results, on the other hand, could be due to the fact that the A shares examined in the study are internationally oriented Chinese firms. For example Efrangji was the first Chinese firm to establish an American Depository Receipt program for its B shares, and approximately 50% of China pencil's sales are generated by exports (Yamaichi, 1994).

Table 1
Exchange and world market risk exposure coefficients

$$R_{it} = [\lambda_0(1-\beta_{rm,i}) + \lambda_{oil}\beta_{oil,i} + \lambda_{fx,i}\beta_{fx,i} + \lambda_{rw}\beta_{w,i}] + \beta_{oil,i}oil_t + \beta_{fx,i}fx_t + \beta_{rw,i}rw_t + v_{it}$$

R_{it} is the log relative stock return (%) for the ith company. A share prices are in RMB yuan and B share prices in US dollars. λ_0 is the rate of return on a zero beta portfolio, λ_{oil} is the premium on the oil price risk, λ_{fx} is the premium on the exchange risk, and λ_{rw} is the premium on the world market risk. $\beta_{rm,i}$, $\beta_{oil,i}$, $\beta_{fx,i}$, and $\beta_{rw,i}$ are exposure coefficients for the market risk, oil price risk, exchange risk, and world market risk factors respectively. The exchange risk factor is denoted, fx_t, the domestic market risk factor, rm_t, oil price factor, oil_t, and world market risk, rw_t.

Firm	A Shares β_{rw}	β_{fx}	B Shares β_{rw}	β_{fx}
Shanghai Vacuum Electrum Devices	0.314	0.047	0.215	-0.646
	(0.54)	(0.06)	(0.46)	(0.59)
Shanghai Erfangji	-0.347	-1.272	1.236	0.555
	(1.14)	(2.67)	(1.36)	(0.292)
Shanghai Dazhong Taxi	0.529	-1.126	-0.807	0.329
Shareholding	(0.42)	(0.53)	(0.86)	(0.17)
Shanghai Wingsung Stationery	-0.830	-0.202	0.699	2.670
	(1.31)	(0.23)	(0.79)	(1.50)
China First Pencil	-0.811	-1.463	-0.120	-1.215
	(1.12)	(1.35)	(0.17)	(0.74)
China Textile Machinery	-0.202	0.497	-0.197	-2.468
	(0.39)	(0.62)	(0.28)	(1.53)
Shanghai Rubber Belt	-2.127	0.527	-0.180	2.080
	(3.76)	(0.737)	(0.30)	(1.52)
Shanghai Chlor-Alkali Chemical	-1.769	-0.451	1.373	0.209
	(2.20)	(0.45)	(1.93)	(0.13)
Shanghai Tyre & Rubber	-0.804	0.379	0.928	-0.558
	(1.26)	(0.35)	(1.06)	(0.32)
Shanghai Refrigerator Compressor	-1.382	2.522	0.898	1.406
	(2.27)	(2.46)	(1.27)	(0.819)
Shanghai Jinqiao Export Processing	-0.516	-0.507	-0.520	2.756
Zone Development	(0.61)	(0.40)	(0.54)	(1.42)
Shanghai Outer Gaoqiao Free	-0.185	-1.059	0.006	2.068
Trade Zone Development	(0.29)	(1.17)	(0.007)	(1.16)
Shanghai Lian Hua Fibre	0.384	-1.694	-0.225	-1.239
	(0.77)	(2.11)	(0.43)	(1.13)

t-statistic in parentheses.

Table 2
Estimates of the risk premium coefficients

$$R_{it} = [\lambda_0(1-\beta_{rm,i}) + \lambda_{oil}\beta_{oil,i} + \lambda_{fx,i}\beta_{fx,i} + \lambda_{rw}\beta_{w,i}] + \beta_{oil,i}oil_t + \beta_{fx,i}fx_t + \beta_{rw,i}rw_t + v_{it}$$

R_{it} is the log relative stock return (%) for the ith company. A share prices are in RMB yuan and B share prices in US dollars. λ_0 is the rate of return on a zero beta portfolio, λ_{oil} is the premium on the oil price risk, λ_{fx} is the premium on the exchange risk, and λ_{rw} is the premium on the world market risk. $\beta_{rm,i}$, $\beta_{oil,i}$, $\beta_{fx,i}$, and $\beta_{rw,i}$ are exposure coefficients for the market risk, oil price risk, exchange risk, and world market risk factors respectively. The exchange risk factor is denoted, fx_t, the domestic market risk factor, rm_t, oil price factor, oil_t, and world market risk, rw_t.

Estimates of A Share Risk Premiums

λ_0	λ_{oil}	λ_{rw}	λ_{fx}
-0.5771	0.9172	0.4341	1.8239
(0.120, 0.014)	(0.375, 0.141)	(0.569, 0.323)	(3.834, 14.703)

Estimates of B Share Risk Premiums

λ_0	λ_{oil}	λ_{rw}	λ_{fx}
-2.9432	3.6468	-4.3119	1.1193
(1.058, 1.120)	(1.489, 2.218)	(-2.472, 6.109)	(1.417, 2.00)

The first number in parentheses is the t-statistic and the second number is the Wald statistic distributed χ^2 one degree of freedom (under the null of coefficient is zero).

4. Conclusion

In this paper we estimate the risk premium for exchange risk in the arbitrage pricing theory framework using non-linear SUR for both B and corresponding A shares listed on the Shanghai stock exchange in China. We find that exchange risk is priced in the A share market and the world market risk factor is priced in the B share market. Thus, we

provide evidence that both B shares and their corresponding A shares are associated with international risk factors.

Notes

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(1) Share ownership is usually classified into three categories: 1) state shares which are held by the government or government agency, 2) legal share which are held by Chinese "legal" entities such as enterprises (not individuals), and 3) public shares which are owned by individuals. The public shares are traded on the exchange. The state and legal shares are issued by the company when it is formed but are not traded on the exchange.

(2) Such segmented markets are not unique to China. Other similar markets include the Singapore stock exchange (Lam and Pak, 1993), the Finnish market (Hietala, 1989), and the Thai market (Bailey and Jagtiani, 1994).

(3) The question of whether exchange risk is priced in the stock market is addressed by several authors [Brown and Otsuki (1993), Dumas and Solnik (1995), Jorion (1991), Choi, Hiraki, and Takezawa (1998), among others]. Song, Liu, Romilly (1998) examine the volaitily pattern of stocks in the Shanghai and Shenzhen stock markets.

(4) We avoided using prices on days when trading did not occur and used the previous trading days closing price instead. All prices used in the study were within the last five trading days of the month.

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裁定取引モデルによる上海株式市場の実証分析

〈要　約〉

竹澤　伸哉

90年代における上海株式市場のA株、B株プレミアムについては、多くの文献が存在している。本研究ノートは、国際的に認識されているリスクファクターが株価に織り込まれているかどうかについて、裁定取引モデルを使った実証分析によって検証する。