Financial integration and international asset pricing of Chinese stock markets[1]

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Abstract

Our analysis draws several meaningful findings. First, we find that there is predictability of Chinese stock market return on latent variables which include common and local specific information. We also find that the conditional volatility and local price of risk are time varying for China. Price of risks for world market as well as China market are derived.

Unconditional multi-factor asset pricing model tests with global factors also yield positive results. Using Hong Kong and US risk factors with Fama-French 3-factor model, we are able to observe higher factor loadings across size and book-to-market sorted portfolios for Chinese market portfolios, implying certain degree of convergence of local and global factor pricing.

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1 Introduction

The inclusion of China A shares to MSCI emerging markets index signals ongoing effort of the Chinese authorities to liberalize its capital markets. We are interested to know from an asset pricing perspective, what are the implications of market liberalization? Has China stock market become more integrated to rest of the world? Can we explain the cross sectional return of China stock market with global risk factors or other regional risk factors? Are factors that worked in other markets also likely to work in China? Our research attempts to answer these questions based on empirical analysis with an expanded set of market data.

Academic research on asset pricing evolves over time and shed some lights on our topic. Research on market integration provides us with methodology to test the financial integration of Chinese stock market. At the same time, increased correlation was found between China and Hong Kong equity market leads us to consider the usefulness of Hong Kong risks factors to explain cross sectional returns in China stock market. The finding of model using local risk factors outperformed global ones inspire us to compare Fama-French model using China, Hong Kong and U.S. data to explain Chinese stock market.

Our research can be divided into two parts. The first part of our empirical work extends the research by Bekaert & Harvey (1995) on world market integration. We include a longer time series and focus on China market specifically. Notations and formulas are directly adopted from their work for easy reference.

The second part consists of cross-sectional analysis of Chinese market returns with global risk factors. The empirical work closely follow Fama & French (2011) on testing multi-factor international asset pricing model.

The rest of the thesis is organized as follows. Chapter 2 presents relevant findings from academic research. Chapter 3 provides the methodology of our analysis, data and summary statistics is presented in Chapter 4. Chapter 5 consists of empirical results and s discussion in Chapter 6. Finally, we conclude in Chapter 7.

2 Literature Review

International asset pricing model is first proposed by Solnik (1974) and Stulz (1981) based on Capital Asset Pricing Model (Sharpe (1964),Littner (1965)) with domestic market portfolio replaced by world market portfolio. It is commonly accepted that in a world with efficient and integrated financial markets a single set of global risk factors should price international stock returns. However, integrated asset pricing is not supported by empirical analysis. In fact, Griffin (2002) , Hou et al (2011), Fama and French (2012) find that models using local risk factors outperformed global ones.

The failure of world portfolio to price assets in the context of international financial market leads to the development of mild-segmentation asset pricing model (Errunza and Losq (1985)), which allows expected returns to vary with world risk as well as conditional market risk, which is a new source of risk that demands a 'super risk premium'. The advantage of these models is that they do not assume perfect market integration or segmentation. However, these models implicitly assume that the degree of market integration does not change over time.

Bekaert and Harvey (1995) show that degree of market integration is in fact time varying. They examine a list of developed and emerging financial markets and propose a way to measure the degree of market integration, drawing from the insight of conditional regime switching model which allows expected returns to vary dynamically with different state of market integration or segmentation.

Asset pricing models that account for local source of risks are particularly relevant to emerging financial markets. Regulations and other barriers have prevented emerging markets from integrating with world financial markets. Investors in emerging markets may not enjoy the risk sharing and diversification benefit that global investors would have otherwise. Companies in emerging market may not have access to global investors and therefore bear a higher cost of capital. A more integrated financial markets could create significant opportunities for both corporates and individuals in emerging markets.

Despite the benefit of financial market integration, Ivan et al (2016) showed that global financial markets have little progress towards fully integrated pricing. The

lack of understanding of emerging market investment, among other regulatory and psychological barriers, prevents global investors to increase their exposure to emerging market investments.

China is an obvious victim of financial market segmentation. Despite its rapid growth in listings and market capitalization, China's stock market retains its reputation as a casino, dominated by retail investors and subject to frequent regulatory interventions and significant restrictions on the tradability of shares. (Carpenter, Lu and Whitelaw (2018))

Testing multi-factor asset pricing model on emerging financial markets could allow investors to understand their various source of risks. Fama and French (1998) included one global market factor and value factor (book value to market value) in international asset pricing model, and they found that value stocks outperform growth stocks in twelve of thirteen major markets. Griffin (2002) then added the size factor and tested whether domestic or world Fama and French's three-factor model better explain international stock returns. The result indicated that local factor model generated better explanations of portfolio and individual stock returns and lower pricing errors than the global factor model.

Fama and French (2010) examined empirical asset pricing model with value, size and momentum factors for four regions (North America, Europe, Japan, and Asia Pacific), in terms of country-specific and integrated versions. They showed that, except Asia Pacific, local models provided the strongest support for explaining local returns in other three regions. Hou, Karolyi, and Kho (2011) concluded that multifactor model based on momentum and cash flow-to-price ratio best captured variation in international stock returns, after studying over 27,000 stocks from 49 countries over a three-decade period.

Analysis on cross-sectional returns in the Chinese stock market is mixed. Chen, Kim, Yao, and Yu (2010), Nusret Cakici and Topyan (2011) and Carpenter, Lu, and Whitelaw (2014) showed strong size and value effect in China equity market, while Wang and Xu (2004), Chen et al (2015) showed significant size effect but no robust value effect.

There is a common question regarding to the firm-level international equity returns: which model explains them best? Although the World CAPM made attempts, this

model does not provide reasonable explanations on firm-level returns across countries as argued in Fama and French (1992), Carhart (1997). No theoretical models show any significant factors such as value and momentum yet, thus studies mainly focus on one simple factor model to explain cross-sectional returns.

Even domestic factors are important to explain local expected returns, the hypothesis of zero abnormal return is usually rejected and expected international stock returns cannot be captured precisely yet. However, previous studies about low correlation between countries showed purchasing overseas equity could be an effective way for risk reduction instead of holding only domestic portfolios Heston and Rouwenhoerst (1994) examined whether industrial structure capture the benefits of international diversification by including companies in MSCI Indices among 12 European countries. They discovered that industry effects had little influence on the cross-sectional volatility, and that country-specific sources of return volatility almost resulted in the low correlation across country indices completely. Therefore, they reached the conclusion that it was much more effective to reduce risk through diversification across countries within an industry than industry diversification within a country. Ferreira and Gama (2005) investigated return variation among developed financial markets at the world, country and local industry levels from 1974 to 2001. The results showed that local industrial risk dominates except 1990-1995 while country risk and global risk impacted most and least on stock volatility systematically

Since we would include many opening up events in China stock market into consideration, we also refer to World plus Local CAPM model. This model offers a benchmark to relevant studies when talking about global events such as cross-listings. Chua, Lai, and Lewis (2010) studied about whether diversifying into domestic portfolios including cross-listed stocks can generate same returns as investing directly in the stocks home markets. Their findings demonstrated that the betas and correlations of the foreign companies in the US market increase after cross-listing. Also portfolios covered foreign firms unlisted in US market, according to the empirical results, worked better on risk reduction when compared with the cross-listed stocks in the same period. Clearly, this suggested that diversification worsen for holding overseas stocks in the US after cross-listing.

Lastly, similar to the tests conducted by Fama and French (1998), Griffin (2002),

Hou, Karolyi, and Kho (2010), and others, we exclude effects of exchange rate risk in our international asset pricing models, even though several researches found out positive relationship between exchange rate risk and expected local return. The reasons are two folded, first, we want to make our research more comparable to past researches, second, we have an implicit assumption that purchasing power parity could invalidate our results.

3 Methodology

3.1 Test on market integration

The first part of our empirical work extends the research by Bekaert & Harvey (1995) on world market integration. We include a longer time series and focus on China market specifically. Notations and formulas are directly adopted from their work for easy reference. For detail, readers may refer to "Time-Varying World Market Integration "(Bekaert & Harvey, 1995).

Asset pricing with time-varying market integration

The model

The Capital asset pricing model (CAPM) by Treynor (1961,1962), Sharpe (1964) and Lintner (1965) suggests that expected returns are linearly proportional to covariance with market portfolio. A conditional version, which assumes complete market integration and no exchange rate risk, imposes the restrictions that

$$E_{t-1}[r^A_{i,t}] = \lambda_{t-1}\mathrm{Cov}_{t-1}[r^A_{i,t}, r_{w,t}], \tag{3.1}$$

where $E_{t-1}[r^A_{i,t}]$ is the conditionally expected excess return on security As equity (in country i), r_w is the return on a value weighted world equity portfolio, Cov_{t-1} is the conditional covariance operator and λ_{t-1} is the conditionally expected world price of covariance risk for time t. All expectations are conditioned on Z_{t-1} the information that investors use to set prices at time $t-1$. The risk-free rate has zero conditional variance because the return is determined at $t-1$.

If complete market segmentation is assumed, the equation will become:

$$E_{t-1}[r^A_{i,t}] = \lambda_{i,t-1}\mathrm{Cov}_{t-1}[r^A_{i,t}, r_{i,t}]. \tag{3.2}$$

Which means that expected return of Asset A is now a function of covariance with market return of country i, and λ_i, which is the local price of risk.

If we aggregate all traded assets in country i, on the left hand side, it will become the expected return of market portfolio, and on the right hand side, its own variance.

$$E_{t-1}[r_{i,t}] = \lambda_{i,t-1} \operatorname{Var}_{t-1}[r_{i,t}], \tag{3.3}$$

Merton (1980) argues that λ_i is a measure of the representative investors relative risk aversion. The model suggests that expected returns in a segmented market are determined by the variance of returns in that market times the price of variance. The price of variance will depend on the weighted relative risk aversions of the investors in country i.

Econometrically, these models can be combined:

$$E_{t-1}[r_{i,t}] = \phi_{i,t-1}\lambda_{t-1}\operatorname{Cov}_{t-1}[r_{i,t}, r_{w,t}] + (1 - \phi_{i,t-1})\lambda_{i,t-1}\operatorname{Var}_{t-1}[r_{i,t}] \tag{3.4}$$

where $\phi_{i,t-1}$ is the conditional integration measure and falls in the interval [0,1]. If $\phi_{i,t-1}$ is one, it implies that only covariance with the world portfolio is priced and we can reject the null hypothesis of market segmentation. If $\phi_{i,t-1}$ is zero, then only variance is priced and we can reject the null hypothesis of market segmentation. This is consistent with a segmented capital market. In addition, the price of risks λ_{t-1} and $\lambda_{i,t-1}$ are allowed to differ. Although the equation (3.4) is not supported by sound equilibrium asset pricing theory, it could serve as a good approximation of the expected returns. Moreover, the methodology proposed by Bekaert & Harvey (1995) characterize the time path of integration in the market by recovering the fitted integration coefficients.

The idea that both the covariance with the world return and the covariance with the local market return affect securities expected returns reaches back to Errunza and Losq (1985) and Eun and Janakiramanan (1986). Following models like Stulz (1981), the returns in (3.1) - (3.4) should be real. Consistent with Bekaert & Harvey (1995), returns are calculated in U.S. dollar terms instead of local term. The excess return should approximate a real return. Such treatment could in fact be more relevant to foreign investors whose assets are based in U.S. dollar or other foreign currencies.

Regime Switching and integraton

The model for expected returns in (3.4) may be considered in the class of regime switching models. In the first regime, markets are integrated and expected returns adhere to (3.1). In the second regime, markets are segmented and expected returns are given by (3.2). Let S_t^i be an unobserved state variable which takes on the value of one when markets are integrated and a value of two when markets are segmented. Then the parameter $\phi_{i,t-1}$ can be interpreted as the conditional probability of being in regime 1, $\phi_{i,t-1} = Prob[S_t^i = 1|Z_{t-1}]$.

Several models are available to estimate $\phi_{i,t-1}$. In the regime switching model developed by Hamilton (1988, 1989, 1990), S_t^i follows a Markov process with constant transition probabilities. Recently, Diebold, Lee and Weinbach (1992), Ghysels (1992) and Gray (1993) have extended the Hamilton model to allow for time-varying transition probabilities. Gray (1993) shows that all these models are special cases of a general finite mixture distribution model with time-varying weights, i.e. $\phi_{i,t-1} = \phi_i(Z_{t-1}^*)$ with $\phi_i(\cdot)$ a functional form that constrains $\phi_{i,t-1}$ to be between zero and one and Z_{t-1}^* a set of variables in Z_{t-1}.

The possibility of time-varying transition probabilities allows for an alternative interpretation of $\phi_{i,t-1}$. Whether a market is integrated with world capital markets or segmented is greatly influenced by economic and financial market policies followed by its government or other regulatory institutions. Hence, $\phi_{i,t-1}$, can be interpreted as a policy weight, varying with policies affecting the degree of market integration. An obvious example is foreign ownership restrictions, often imposed by developing countries.

If a asset pricing model is specified correctly, the regime switching model could infer the degree of market segmentation. Whereas it is in general difficult to conclude the genuine level of market integration simply based on a set of restrictions imposed by any country at an given time. There are many forms of investment barriers, both created by local market players or foreign market players. At the same time, not all barriers are necessarily preventing investors from participating into a financial market. Country funds, dual listing and

To infer $\phi_{i,t-1}$ from the data, Bekaert & Harvey (1995) explore two different

regime switching models. The first is the standard Hamilton model. Although the switching probabilities are time invariant, the regime probability and hence the degree of market integration varies through time as new information changes the econometricians inference on the relative likelihood of the two regimes. Gray (1993) derives the following recursive representation for the regime probability:

$$\phi_{t-1} = (1-Q) + (P+Q-1)[\frac{f_{1,t-1}\phi_{t-2}}{f_{1,t-1}\phi_{t-2} + f_{2,t-1}(1-\phi_{t-2})}], \tag{3.5}$$

where the country i subscript has been suppressed and

$$P = Prob[S_t = 1 | S_{t-1} = 1]$$
$$Q = Prob[S_t = 2 | S_{t-1} = 2]$$

and $f_{j,t}$ is the likelihood at time t conditional on being in regime j and time $t-1$ information, $\mathcal{Z}_{\sqcup -\infty}$

In the second formulation, we allow the transition probabilities P and Q to be time varying. In particular, we model them as logistic functions of Z^*_{t-1}:

$$\begin{aligned} P_t &= \frac{exp(\beta_1' Z^*_{t-1})}{1 + exp(\beta_1' Z^*_{t-1})} \\ Q_t &= \frac{exp(\beta_2' Z^*_{t-1})}{1 + exp(\beta_2' Z^*_{t-1})} \end{aligned} \tag{3.6}$$

where β_j , $j = 1, 2$, are vectors of parameters. In implementing this model, we let Z^*_{t-1} be a subset of Z^i_{t-1} where Z^i_{t-1} is a collection of information variables specific to country i which includes lagged dividend yields and lagged equity market capitalization as a proportion of GDP. Since all of these variables might be influenced by a change in policies affecting market integration, they should influence the switching probabilities. Although it is possible that global information variables are also important in determining the switching probabilities, we only allow the global variables to influence the probabilities indirectly through their correlation with the local information variables.

Estimation issue

The likelihood function

To complete the model described in (3.4), we need an auxiliary assumption on the movement of expected returns on the world equity portfolio. Consequently, we estimate a series of bivariate models for $\mathbf{R}_{i,t} = [r_{i,t}, r_{w,t}]\prime$:

$$\begin{aligned} r_{i,t} &= \phi_{i,t-1}\lambda_{t-1}\mathrm{Cov}_{t-1}[r_{i,t}, r_{w,t}] + (1-\phi_{i,t-1})\lambda_{i,t-1}\mathrm{Var}_{t-1}[r_{i,t}] + e_{i,t} \\ r_{w,t} &= \lambda_{t-1}\mathrm{Var}_{t-1}[r_{w,t}] + e_{w,t} \end{aligned} \tag{3.7}$$

Let $\mathrm{e}_t = [e_{i,t}, e_{w,t}]\prime$ and define $\mathrm{e}_t^I(\mathrm{e}_t^S)$ as the disturbance vector under integration (segmentation):

$$\mathrm{e}_t = \phi_{i,t-1}\mathrm{e}_t^I + (1-\phi_{i,t-1})\mathrm{e}_t^S. \tag{3.8}$$

We assume that the residuals are heteroskedastic,

$$\begin{aligned} E[\mathrm{e}_t^I \mathrm{e}_t^{I\prime} | Z_{t-1}] &= \Sigma_t^I. \\ E[\mathrm{e}_t^S \mathrm{e}_t^{S\prime} | Z_{t-1}] &= \Sigma_t^S \end{aligned} \tag{3.9}$$

The conditional variance dynamics are modeled as ARCH(k) following Baba, Engle, Kraft and Kroner (1989) (BEKK):[2]

$$\begin{aligned} \Sigma_t^I &= C^I + (A^I)'[\sum_{k=1}^{K} w_k(\mathrm{e}_{t-k}\mathrm{e}'_{t-k})]A^I, \\ \Sigma_t^S &= C^S + (A^S)'[\sum_{k=1}^{K} w_k(\mathrm{e}_{t-k}\mathrm{e}'_{t-k})]A^S \end{aligned} \tag{3.10}$$

where C^I and C^S are symmetric 2x2 matrices, A^I and A^S are 2x2 matrices. An advantage of this model of conditional variances is that it guarantees positive definite conditional variance matrices under weak conditions. In addition, the model imposes restrictions across equations and thereby economizes on parameters relative to other multivariate ARCH models.

To further limit parameter proliferation, we impose the additional restrictions:

$$\begin{aligned} &C^I(2,2) = C^S(2,2), \\ &A^I(j,j) = A^S(j,j) \qquad\qquad for j = 1,2, \\ &A^I(1,2) = A^S(1,2) = 0, \\ &\quad and \\ &A^S(2,1) = 0. \end{aligned} \tag{3.11}$$

The first and second restrictions make the conditional variance of the world market return independent of the regime. The restriction $A^I(1,2) = A^S(1,2) = 0$ ensures that country specific shocks do not affect the conditional variance of the world market return. The restriction $A^S(2,1) = 0$ ensures that the world market shocks do not affect the conditional variance of the country return when the market is segmented.[3] The dynamics of the conditional variances are constrained to be the same in both regimes. In the estimation, we set $K = 3$ and let $w_k = 2(K+1-k)/(K(K+1))$ as in Engle, Lilien and Robbins (1987). The resulting weights on the three past residual vectors are 1/2, 1/3 and 1/6, respectively. The evidence presented in Campbell (1987) and Harvey (1989, 1991a) suggests that the price of risk is time varying. In the most general version of the model, we let:

$$\begin{aligned} \lambda_{t-1} &= exp(\delta' \mathbf{Z}_{t-1}) \\ \lambda_{i,t-1} &= exp(\delta_i' \mathbf{Z}^i_{t-1}) \end{aligned} \tag{3.12}$$

where $\mathbf{Z}$ represents global information variables and $\mathbf{Z}^i$ represents a set of local information variables. A similar assumption underlies much of the latent variables literature [Hansen and Hodrick (1983) and Gibbons and Ferson (1985)] and has recently been imposed by Dumas and Solnik (1993) and Dumas (1994). The exponentiation imposes one of the necessary conditions of the asset pricing theory that the price of risk is positive.

The model is estimated by maximum likelihood assuming normally distributed error terms. The log-likelihood function, apart from some initial conditions, can be

written:

$$\begin{aligned} \log L(\mathbf{R}_{i,T} &= \sum_{t=1}^{T} \log(\phi_{i,t-1} g_{1,t} + (1-\phi_{i,t-1}) g_{2,t}) \\ with \quad g_{1,t} &= (2\pi)^{-1} |\Sigma_t^I|^{-1/2} \exp(-0.5 (e_t^{I\prime} (\Sigma_t^I)^{-1}) e^I), \\ g_{2,t} &= (2\pi)^{-1} |\Sigma_t^S|^{-1/2} \exp(-0.5 (e_t^{S\prime} (\Sigma_t^S)^{-1}) e^S) \\ \mathbf{R}_{i,T} &= [R_{i,1}, R_{i,2}, \ldots, R_{i,T}] \end{aligned} \tag{3.13}$$

where T is the sample size and $\phi_{i,t-1}$ is the integration measure previously specified. The parameter vector is given by

$$\Theta = [\delta', \delta_i', \text{Vech}(C^I), C^S(1,1), C^S(1,2), A^I(1,1), A^I(2,1), A^I(2,2), \beta']'$$

where β summarizes the parameters needed to estimate $\phi_{i,t-1}$. Under very weak assumptions, including misspecification of the error distribution function [see White (1982)], the vector of parameters, Θ, is asymptotically normally distributed with covariance matrix $\mathbf{A}^1\mathbf{B}\mathbf{A}^1$, where $\mathbf{A}$ is the Hessian form and $\mathbf{B}$ the outer product form of the information matrix. Below, we report robust standard errors.

Rather than estimating the likelihood function in (3.13) directly, we proceed in two steps. First, we estimate $C^I(2,2)$, $A^I(2,2)$ and δ using the world market return and the world information variables, $\mathbf{Z}$. Second, we estimate (3.13) country by country imposing the parameter estimates from the first stage. This procedure imposes the restriction that the price of world market risk is the same in each country, which leads to more powerful tests. A disadvantage to this approach is that the usual standard errors are likely to be understated since we ignore the sampling error in the first-stage parameter estimates.

Specification tests and diagnostics

Many of the markets in our sample show predictable variation in returns. In contrast to previous work, our model has three sources of time-variation in expected returns: variation in the price of risk $(\lambda_{t-1}, \lambda_{i,t-1})$, variation in the conditional risk measures (covariance with world and local market variances) and variation in the degree of market integration $(\phi_{i,t-1})$. Our estimation technique allows us to recover the time

path of all three components. To gauge the ability of the model to capture the observed predictability of returns, we test where the time t disturbance e_t is orthogonal to information $\mathcal{Z}_{t-1}$ available at time $t-1$ The first set of diagnostics reports the R^2 and a heteroskedasticity-consistent Wald test of the joint significance of the coefficients of a linear regression of $e_{i,t}$ onto a set of information variables $\mathcal{Z}_{t-1}$. If the model fails to replicate the observed time-variation of expected returns, it is useful to track the source of the rejection. Hence, we set $\mathcal{Z} = \mathbf{Z}$, $\mathcal{Z} = \mathbf{Z}_{t-1}$, and $\mathcal{Z} = [\mathbf{Z}, \mathbf{Z}^i]$. Misspecification of the world market return equation is also possible. Therefore, we also regress $e_{w,t}$ onto $\mathbf{Z}_{t-1}$.

We then estimate three alternative models embedded in the general specification (3.5) to (3.11). In the first alternative, we assume constant prices of risk and provide a likelihood ratio test of this restriction. The second alternative constrains the conditional variances to be constant over time (no ARCH). This produces a second likelihood ratio. Finally, in the third alternative, the degree of integration is constrained to be constant over time. In the standard Hamilton model, this alternative is nested by setting $1 - Q = P$. It corresponds to a standard mixture of normals model (see Everitt and Hand (1981)). This delivers the final likelihood ratio.

Finally, we also report a likelihood ratio test of the standard Hamilton model versus a model with time-varying transition probabilities. When the Hamilton model is rejected, the constant prices of risk and no ARCH models are estimated using time-varying transition probabilities.

3.2 Test on asset pricing models

To perform the asset-pricing test in China A-share market, we follow the Fama and French (1993) three-factor model to run the time-series regression on 25 size-value sorted portfolios.

$$R_t^p - R_{f,t} = \alpha_p + \beta_p^M (R_{M,t} - R_{f,t}) + \beta_p^{SMB} SMB_t + \beta_p^{HML} HML_t + \varepsilon_t^p$$

Where $R_t^p - R_{f,t}$ is the excess return on the portfolio at month t, $R_{M,t} - R_{f,t}$ is the excess return on the market portfolio at month t, SMB_t is the return on a diversified portfolio of small stocks minus the return on a diversified portfolio of big stocks,

HML_t is the difference between the returns on diversified portfolio of high and low B/M stocks.

To test Chinese stock market integration, we employ the Fama and French model (1993) with domestic and global factors. For foreign factors, we include Hong Kong stock three factors and the US stock three factors separately since Hong Kong stock market has close relationship with Chinese stock market and the US stock market is highly integrated into world capital market.

Also according to the main opening up events in Chinese stock market, we split the whole observation time into two periods by the end of 2007 (after Through-train to Hong Kong's stock market) or 2014 November (Shanghai-Hong Kong Stock Connect), and then change the time of segmentation every half year.

In detail, we would run time series regressions for A-share stock market from 1997 July - December 2007 and 2008 January - 2017 September, 1997 July - 2008 June and 2008 July - 2017 September. . . until 1997 July - 2014 October and 2014 November to 2017 September.

By dividing time and regional three factors, we could compare the abnormal returns under various conditions then examine our hypothesis, global factors should result in a smaller alpha since China's stock market becomes more and more integrated.

As we estimate Chinese stock market is much more integrated recently, regression results would indicate a smaller intercepts in our global-factor asset pricing model than in the local three-factor model. In addition, F-test of Gibbons, Ross and Shanken (GRS,1989) helps us to examine whether all abnormal returns are equal to zero. If the F-statistic is above the threshold under certain level, we can reject the Fama French (1993) three factor model. Otherwise, we cannot reject the model.

4 Data and Summary Statistics

4.1 Data source

Equity market indices

The monthly equity returns data for world market and China are collected from MSCI Inc. (MSCI) and FTSE Russell (FTSE) respectively. We also include monthly equity returns for USA and Hong Kong as comparison, both from MSCI Country Index.

The MSCI World Index is a market capitalization weighted stock market index of 1,649 stocks from companies throughout the world, and is used as a common benchmark for 'world' or 'global' stock funds intended to represent a broad cross-section of global markets. For the MSCI indices we include, they all begin in December 1969. Returns are calculated in US dollar with dividend reinvested.

FTSE China Index is a market-capitalization weighted, free float adjusted indexes designed to represent the performance of Chinese A Shares that are available to international investors, incorporating stocks listed on the Shanghai and Shenzhen Stock Exchanges including the Shenzhen ChiNext Board. It has a start date in January 1994. Similar to MSCI indices, returns are calculated in US dollar with dividend reinvested.

Global and country specific information

We also include a series of global and country specific information as instrumental variables for analyzing expected returns. The choice of global variables follows Bekaert and Harvey (1995) and includes The world market dividend yield in excess of the 30-day Eurodollar date, the default spread (Moodys Baa Aaa bond yields), the change in term structure spread (US 10-year bond yield minus 3-month US bill), and the change in the 30-days Eurodollar rate. These variables are designed to capture the volatility in expectations of global business cycle.

For China specific instrumental variable, we include local equity return, local exchange rate changes, local dividend yields, and the ratio of equity market capitalization to gross domestic products.

Cross-sectional analysis of Chinese equity returns

For cross-sectional analysis of Chinese equity returns, we draw data from multiple sources. Since we follow the the Fama and French (1993) three-factor model in this part, data used here are the excess returns of A-share, local and foreign three risk factors.

For local analysis, we mainly use data from RESSET database. It provides complete information about Chinese stock market. Many academic researches refer to RESSET database in China. Zeng, Zhang and Wei (2013) cite information about Chinese listed firms from RESSET database study about the how financial crisis would impact the finance flexible reserves and corporate investment Behavior. Yang (2013) also performs empirical analysis on ETF fund flow, market returns, and investor sentiment in Chinese A-share market based on the fund data in RESSET database. Using the stock and macro data, Zhang (2013) completes the correlation research on Chinese stock market and macroeconomic.

Specifically, we select historical monthly A-share excess returns based on 25 size-value sorted portfolios. Also domestic three risk factors from RESSET database is employed in this study. Regarding to global factors, we adopt US three risk factors in Kenneth French's Data Library and Hong Kong three risk factors from Data Library of AQR Capital Management. All selected data in this part are calculated on a monthly basis.

We employ the 25 portfolios formed on the basis of size and book-to-market from RESSET Database. Particularly, the risk free rate in RESSET Database refers to adjusted monthly rate based on 3-month term deposits interest rate from July 1992 to August 6th 2002, 3-month central bank bill coupon rate from August 7th 2002 to October 7th 2006, the 3-month Shanghai Interbank Offered Rate (the 3-month Shibor) since October 8th 2006, respectively. There are many discussions about the selection of the risk free rate in China. Different from developed markets, China

has a relatively high risk free rate, normally around 3.40%3.80%. Since no standard risk free rate in China yet, household saving rate, the seven-day interbank repo rate and interbank lending interest rate are all often referred in academic debate. In this paper, we would follow the same Chinese risk free rate as RESSET Database to align data. Also, our results are all based on monthly data.

For time horizon under study, we exclude the early data of the Chinese stock markets and conduct our reearch starting from 1997:7. The quality of data is questionable especially in early days when People's Republic of China has just opened her first stock exchange in 1990. Only a very limited number of firms are listed. For instance, 8 A-shares in 1990 and 91 A -shares by the end of 1995 listed on Shanghai Stock Exchange. Just a few years to July 1996, the number of listing A-shares proliferated to over 500.

The second consideration is that we use risk factors from Hong Kong equity market to build to test the significance to Chinese A-shares market. The stock market of Hong Kong has been very integrated with the world market, thanks to its unique position as the global financial centre in Asia. There is no restriction of capital flow and global investors can access to the market freely. The use of common law system and a dollar-pegged local currency also make Hong Kong one of the most attractive destination for financial activities. Before 1990s, the Hong Kong stock market is mainly influenced by local as well as global risk factors. As Hong Kong started to welcome Chinese companies to list in local stock exchange, the equity market becomes more influenced by Chinese related risk factors.

China's stock market has been famous for various forms of trade suspensions. Lastly, Chinese Securities Regulatory Commission changed related regulations and polices quite often before 1996. Specifically, for the price limit policy in China, all A-shares and B-shares are required to follow the 10% price limits policy now which were published on December 13, 1996 and implemented on December 16, 1996. However, before that, both Shanghai and Shenzhen exchanges experienced high volatility. In detail, Shanghai Stock Exchange cancelled price limit on 21st May, 1992 and SSE Composite Index jumped to the yearly highest point of 1429.01 just in 5 days later. Since 1997, the regulatory system in China's stock market was improved, providing a more stable environment to the A-shares market.

Based on the factors discussed above, we would restrict our sample from 1997 July to 2017 September to simplify our analysis. Even in a short period, our sample covers a rich data under a relatively steady status in terms of both regulatory environment and market fluctuations.

4.2 Summary Statistics

Table 4.1 reports the annualized means, annualized standard deviations and auto-correlations of monthly equity market returns, as well as the instrumental variables. All returns are calculated in US dollar with dividend reinvested. For MSCI indices, the observation starts from January 1971 through December 2017 (564 months). For FTSE China Index, the observation starts from January 1994 through December 2017 (288 months). Both the world market and the USA market deliver lower unconditional average returns (10.6% and 11.0%) than Hong Kong and China (18.9% and 15.6%). However, the high average returns of Hong Kong and China comes with a significantly higher volatilities (34% and 33%) compared to world market and USA (14.6% and 15.0%). Investing in world market offers higher risk adjusted returns. Interesting, however, by including 2017 data, US market actually provide even better risk adjusted returns than the world market.

A few global and local instrumental variables demonstrate highly persistent autocorrelations. Dividend yields, both global and local, as well as default spreads, are very persistent. For other global instruments, Bekaert & Harvey apply first-differencing to achieve stationarity. Local currency return for China has been pretty stable since 1994 as Chinese government underwent a series of currency reform, and was pegged with US dollars in most of the 2000s. Market capitalization to GDP could serve as a value based signal although it could be influenced by addition of new shares in Chinese stock markets.

Table 4.1: Summary Statistics for the Country Returns and the Instrumental Variables

The statistics are based on monthly data from 1971:1-2017:12 (564 observations). The country returns are calculated in U.S. dollars in excess of the holding period return on 30-day Eurodollar deposit rate. The dividend yields are the average (over the past year) monthly dividends divided by the current month price level. The returns and dividend yields are from S&P 500 index.
The global information includes: the return for holding a 10-year U.S. Treasury bill for 1 month less the return on a 3-month bill (Term spread), the yield on Moody's Baa rated bonds less the yield on Moody's Aaa rated bonds (Credit spread), change in 30-day Eurodollar deposit rate, and the dividend yield on the Standard and Poor's 500 stock index less the return on 30-day Eurodollar deposit rate (excess dividend yield).
Country specific information includes: local dividend yield, local currency return and market capitalization to GDP.

			Autocorrelation					
Variable	Mean	Std. Dev.	ρ_1	ρ_2	ρ_3	ρ_4	ρ_{12}	ρ_{24}
A. Equity returns (1971:1 - 2017:12)								
World	10.593	14.558	0.092	-0.039	0.067	0.030	0.052	0.022
Hong Kong	18.923	34.055	0.071	-0.024	-0.016	-0.057	-0.039	-0.005
USA	11.032	14.970	0.033	-0.031	0.051	0.015	0.060	0.001
China (1994:1-2017:12)	15.626	33.152	0.139	0.066	-0.059	-0.042	-0.034	-0.061
B. Global instrumental variable (1971:1 - 2017:12)								
S&P500 Dividend Yield	2.907	1.238	0.995	0.987	0.980	0.972	0.904	0.852
1 month Eurodollar	1.092	0.451	0.963	0.904	0.848	0.798	0.422	0.185
Moody's Baa - Aaa	6.464	3.039	0.995	0.987	0.980	0.974	0.920	0.853
Term spread	4.721	3.447	0.991	0.976	0.963	0.951	0.866	0.710
C. China instrumental variable (1994:1 - 2017:12)								
Local Dividend Yield	4.335	2.512	0.900	0.820	0.724	0.637	0.248	-0.133
Local currency return	1.228	1.871	0.277	0.090	0.089	0.182	0.031	-0.114
Market cap. to GDP	0.428	0.238	0.980	0.956	0.926	0.893	0.562	0.386

5 Empirical Results

5.1 Predictability of country returns on global and local information

A number of studies have documented the existence of predictable variation in developed country returns. Recently, evidence of predictable variation in emerging market returns has been documented in Bekaert (1994), Buckberg (1993) and Harvey (1993, 1994).

To test the predictability of Chinese market returns , we run several predictive regressions using global and local information. Each of the monthly returns are regressed against information with one period lag. The purpose of predictive regression is to test whether a given set of information can predict returns in the following period. Regression coefficients and robust standard errors are reported in the following table. To account for any potential heteroskedasticity issue that arise from time series return data, a robust standard error is used instead of OLS standard errors.

Both local information and global information generate 3% monthly R^2 with a standard error of 9%. However, if we regress Chinese market returns on both global and local information, the monthly R^2 increases to 6%.

We also conduct heteroskedasticity consistent exclusion tests of the null hypothesis that expected returns are constant. Linear projections of information that exclude global, local and global/local are tested. We generate highly significant coefficients which rejects the null hypothesis at 5% significant level. The results are reported in table 5.3.

Table 5.1: Regressions of Country Returns on the Common Set of Instrumental Variables

The regressions are based on monthly data from 1994:1-2017:12 (288 observations). The country returns are calculated in U.S. dollars in excess of 30-day Eurodollar deposit rate. The equity data are from FTSE Russell. Standard errors in brackets are heteroskedasticity consistent. The model estimated is:

$$r_{i,t} = \delta_{J,0} + \delta_{J,1} xusdiv_{t-1} + \delta_{J,2} usjunk_{t-1} + \delta_{J,3} term_{t-1} + \delta_{J,4} ed30_{t-1} + \varepsilon_{j,t}$$

The conditioning information is a set of global information variables which include a constant, the world market dividend yield in excess of the 30-day Eurodollar rate, the default spread (Moody's Baa minus Aaa bond yield), the change in the term structure spread (U.S. 10-year bond yield minus 3-month U.S. bill), and the change in the 30-day Eurodollar rate.

δ_0	δ_1	δ_2	δ_3	δ_4	R^2
-0.0011	-0.0012	0.0118	0.0274	-0.0400	3%
[0.0164]	[0.0025]	[0.0149]	[0.0240]	[0.0210]	

Table 5.2: Regressions of Country Returns on the local Set of Instrumental Variables

The regressions are based on monthly data from 1994:1-2017:12 (288 observations). The country returns are calculated in U.S. dollars in excess of 30-day Eurodollar deposit rate. The equity data are from FTSE Russell. Standard errors in brackets are heteroskedasticity consistent. The model estimated is:

$$r_{i,t} = \delta_{J,0} + \delta_{J,1} CNYRET_{t-1} + \delta_{J,2} CNYDIV_{t-1} + \delta_{J,3} CNYUSD_{t-1} + \delta_{J,4} MKTGDPt - 1 + \varepsilon_{j,t}$$

The instrumental variables are: a constant, lagged local equity return ($CNYRET$), local dividend yield ($CNYDIV$), the return for holding local currency for 1 month ($CNYUSD$), and total market capitalization to GDP($MKTGDP$).

δ_0	δ_1	δ_2	δ_3	δ_4	R^2
-0.0051	0.1171	0.0037	0.3849	-0.0035	3%
0.0193	0.0596	0.0025	1.0444	0.0260	

Table 5.3: Predictability using local and global information

Heteroskedasticity-consistent tests of the null hypothesis that expected returns are constant. The multivariate test of no predictability using the global information variables for China provides evidence against the null hypothesis. The null hypothesis of no predictability is rejected at the 5% level. In addition, the table shows that the combination of global and local variables enhances the degree of predictability. A multivariate test using the local information variables also provides a rejection of the null hypothesis at the 5% level of significance.

The global information variables include: a constant, the world market dividend yield in excess of the 30-day Eurodollar rate, the default spread (Moodys Baa minus Aaa bond yields), the change in the term structure spread (U.S. 10-year bond yield minus 3-month U.S. bill), and the change in the 30-day Eurodollar rate. These variables are designed to capture fluctuations in expectations of the world business cycle.

The set of local information variables include: a constant, local equity returns, local exchange rate changes, and local dividend yields and the ratio of equity market capitalization to GDP. These variables are designed to capture expectations about local economic conditions. All returns are calculated in US dollars.

Country	Exclude global		Exclude local		Exclude global + local	
	χ^2	p-value	χ^2	p-value	χ^2	p-value
FTSE China Index (1994:1-2017:12) U.S. dollar returns						
China	9.09	0.0106	10.09	0.0065	17.69	0.0001

All tests are heteroskedasticity consistent.
Country tests are based on univariate regressions.

5.2 Time variation in the world price of covariance risk

Consistent with the approach suggested by Bekaert & Harvey (1995), we estimate the world price of covariance risk with ARCH-M model, and show that price of covariance risk displays time varying properties. Table 5.4 presents our findings.

We also plot the fitted world price of risk in figure 5.2 and 5.2. The fitted world price of risk generated by the full model successfully captures the Global Financial Crisis and previous economic downtowns. Price of risk is highest during economic downturn and lowest during prosperity. This is consistent with the consumption view of asset pricing model.

In our analysis we are unable to generate a positive definite Hessian matrix for panel B and panel C, which prevents us from conducting significance tests. However, the fitted plots show that world price of risk suggested by constant variance model has more extreme value during the Global Financial Crisis and too low the price in the early years of estimation. World price of risk suggested by full model is more reasonable. We believe an ARCH-M with time varying price of risk better represent the actual economy.

Table 5.4 presents the estimation of the ARCH-M model for the world price of covariance risk:

$$r_{w,t} = \lambda_{t-1}\mathrm{Var}_{t-1}[r_{w,t}] + \epsilon_{w,t}$$

$$\lambda_{t-1} = exp(\delta'\mathbf{Z}_{t-1})$$

where $\mathrm{Var}_{t-1}[r_{w,t}]$, is given by:

$$h_t = c^2 + \alpha^2 \sum_{k=1}^{K} w_k \epsilon_{w,t-k}^2$$

Table 5.4: The world price of covariance risk

The model estimated is:

$$r_{w,t} = \lambda_{t-1}\mathrm{Var}_{t-1}[r_{w,t}] + \epsilon_{w,t}$$
$$\lambda_{t-1} = exp(\delta'\mathbf{Z}_{t-1})$$

where r_w is the world market return, λ is the world price of covariance risk, ε_w is the return disturbance, and the conditional variance, $h_t = \mathrm{var}_{t-1}[r_{w,t}]$, is given by:

$$h_t = c^2 + \alpha^2 \sum_{k=1}^{K} w_k \epsilon_{w,t-k}^2$$

The conditioning information, $\mathbf{Z}$ is a set of global information variables which include a constant, the world market dividend yield in excess of the 30-day Eurodollar rate, the default spread (Moody's Baa minus Aaa bond yield), the change in the term structure spread (U.S. 10-year bond yield minus 3-month U.S. bill), and the change in the 30-day Eurodollar rate. In the estimation, we set $K = 3$ and let $w_k = 2(K + 1 - k)/(K(K + 1))$ as in Engle, Lilien and Robbins (1987). The resulting weights on the three past residual vectors are 1/2, 1/3 and 1/6, respectively. The χ^2 statistics in Panel B provides a test of whether the conditional variance is constant. It has one degree of freedom. The χ^2 statistics in Panel C provides a test whether the price of risk is constant. It has 4 degree of freedom.

Panel A: Full model

δ_1	δ_2	δ_3	δ_4	δ_5	c	α
1.888	0.144	-0.207	-0.321	-0.393	0.034	0.605
[0.469]	[0.090]	[0.370]	[0.631]	[0.329]	[0.002]	[0.069]

Panel B: Constant variance model

δ_1	δ_2	δ_3	δ_4	δ_5	c	χ^2
1.999	2.019	0.122	2.238	2.409	0.042	NM
[1.087]	[0.719]	[0.411]	[1.405]	[0.521]	[0.002]	NM

Panel C: Constant price of risk

λ	c	α	χ^2
1.695	0.040	0.360	N.M.

Figure 5.1: World price of risk: Panel A (Full Model)

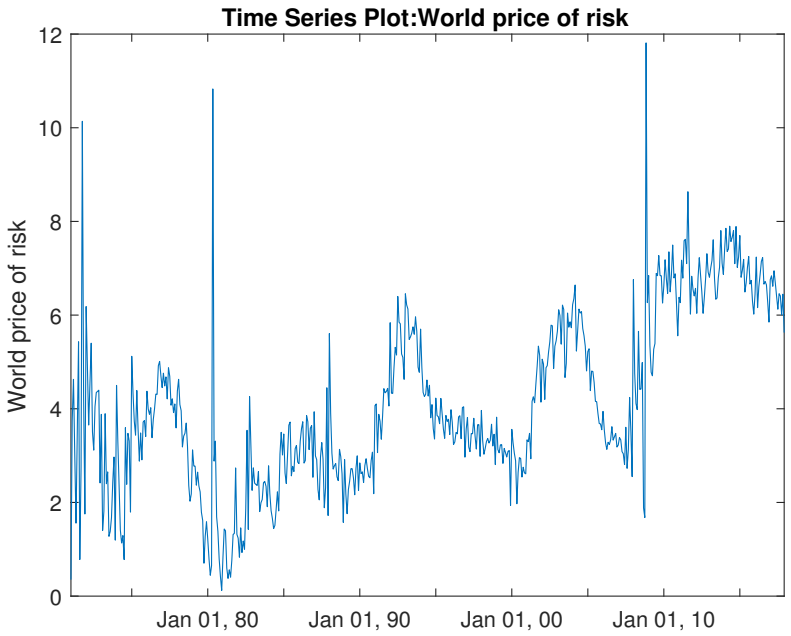
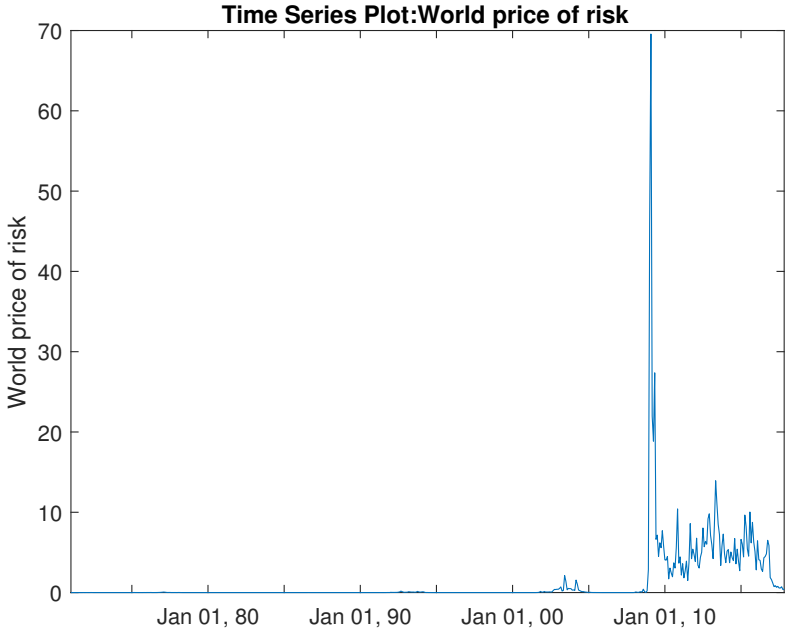


Figure 5.2: World price of risk: Panel B (Constant Variance Model)



While computational issue prevent us from estimating a regime switching model with bivariate returns, constructing price of risk for Chinese equity market would yield interesting observations and will be useful for further research.

We follow the procedures similar to world price of risk, with global information replaced by China specific local information. The set of local information variables include a constant, lagged local equity return, local dividend yield , the return for holding local currency for 1 month, and total market capitalization to GDP.

We find that the fitted price of risk for China is pretty noisy compared with the world price of risk. One potential explanation lies in the ARCH term which is significantly higher for China (0.784). As variance is a function of squared residuals in BEKK model, any change in residuals will be amplified by a large ARCH term, causing volatility in local price of risk.

Figure 5.3: China price of risk

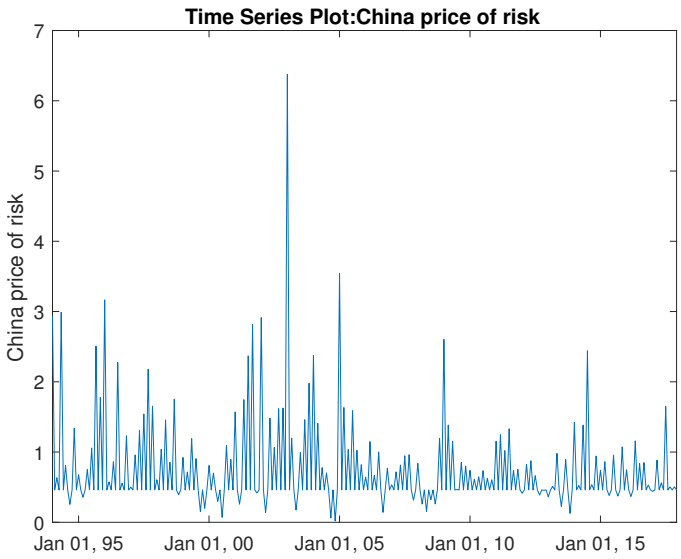


Table 5.5: China price of covariance risk

The model estimated is:

$$r_{i,t} = \lambda_{i,t-1}\mathrm{Var}_{t-1}[r_{i,t}] + \epsilon_{w,t}$$
$$\lambda_{t-1} = exp(\delta'\mathbf{Z}_{t-1})$$

where r_i is the China market return, λ_i is the China price of covariance risk, ε_i is the return disturbance, and the conditional variance, $h_t = \mathrm{var}_{t-1}[r_{i,t}]$, is given by:

$$h_t = c^2 + \alpha^2 \sum_{k=1}^{K} w_k \epsilon^2_{w,t-k}$$

The conditioning information is a set of local information variables which include a constant, lagged local equity return, local dividend yield , the return for holding local currency for 1 month, and total market capitalization to GDP.
In the estimation, we set $K = 3$ and let $w_k = 2(K + 1 - k)/(K(K + 1))$ as in Engle, Lilien and Robbins (1987). The resulting weights on the three past residual vectors are 1/2, 1/3 and 1/6, respectively.

Panel A: Full model

δ_1	δ_2	δ_3	δ_4	δ_5	c	α
-0.775	1.732	-7.794	0.048	-0.042	0.062	0.784
[1.506]	[3.554]	[5.017]	[0.103]	[0.541]	[0.011]	[0.146]

6 Cross-section analysis of global factors on Chinese market returns

The main intentions to perform the Fama French test in our paper are, firstly we would like to test the significance of global factors to price Chinese equity market then whether give an increase in level of integration of Chinese equity market to world market; secondly, we would examine the significance of various risk factors to understand the characteristics of Chinese equity market.

The reason we use simple Fama-French three factor model is that our purpose is not about finding new factors which could better explain the cross section of expected returns. Neither are we interested in building a new asset pricing model to replace Fama-French three factor model. We are primarily interested in understanding the usefulness of global information to price local asset returns over time. Therefore, a sound theory with long history of data allow us to better understand the fundamental characteristics of the proposed market.

To summarize our findings, we only provide regression results with a clear shift in trending, which makes 2014 November, the launch of Shanghai-Hong Kong Stock Connect, an eligible split time in this case. Therefore, we include 6 tables of time-series regression of three models: local three-factor model, Hong Kong (HK) three-factor model and the United States (US) three-factor model, and two sample periods: July 1997 to October 2014 and November 2014 to September 2017. Tables of regression results can be checked in the Appendix.

Unsurprisingly, we see local factors dominate global factors in pricing Chinese equity return during the two sample periods July 1997 to October 2014 and November 2014 to September 2017. We then conclude that domestic factors do a better job at pricing local equity return in Chinas stock market. Nevertheless, R^2 improves significantly for global factors (both HK and US) in recent years, indicating that world factors capture the excess turns of A-share better after Shanghai-Hong Kong Stock Connect.

Despite that, we can see that global factors become more useful, proven by a

higher factor loading (higher betas) as well as rising significance in betas. Based on 5x5 size-B/M sorted portfolios, we see loadings on Hong Kong factors change in the opposite direction in different sample periods. In detail, there are higher beta loading on both value and size after November 2014 while betas on value and size drop before October 2014, compared with betas under local pricing model during same period.

For instance, coefficient of size factor jumps from 1.2360 to 1.5112 for portfolio in size level 1 and value level 1, which is significant under 0.01 level. Meanwhile, this number increases from -0.4152 to 0.4869 regarding to portfolio size level 4 and value level 5, also significant at 0.05 level.

In our expectation, big size portfolio should be more affected by global factors if the market has become more integrated. Also value portfolio should show factor loading significance, implying value strategy should work in China due to a higher level of integration in this market.

For Hong Kong factors, big size and high B/M portfolio produces positive and significant factor loading on HML, which could suggest that value strategy could make excess returns in China. The time series regression of big and value portfolio generates 0.3208, 0.2578 and 0.3012 for Fama-French three factors, significant under 0.05 level from July 1997 to October 2014.

Loading on MKT_{HK} is higher over time, suggesting the Chinese equity return has becoming increasing sensitive to Hong Kong market return. That could be the result of increasing number of dual listing large companies in HK and China as well as increasing exposure of Hong Kong stock market to China. We observe many significant size betas using Hong Kong factors, and the orders are in the right direction, smaller portfolio produces higher size factor loading. It is perhaps interesting to conclude that China equity market behaves similarly to Hong Kong small companies, a phenomenon which is worth exploring.

For US factors, despite the non-significant of most, it is obvious that betas of all three factors increase apparently during sample period after October 2014, might showing that the US three factor model explain A-share excess return better after Shanghai-Hong Kong Stock Connect. For the first period, loadings on HML factor indicate a rising trend when book-market value improves from 1 to 5 and size stays the same. The similar situation happens to the movement of coefficient of SMB.

Regarding to the second period, we see value effect among portfolios formed on big firms. For portfolios in largest size, the loading on B/M factor jumps to 0.3882 for value portfolio, from -0.3825 for growth portfolio. This, somewhat reveal that investors following value strategy among big stocks in Chinese market could make profits.

Results of GRS Test

Table 6.1: GRS test summary

	CN Three-Factor				
Period	GRS	$\|a\|$	R^2	s(a)	SR(a)
199707-201709	1.4902	0.0018	0.9392	0.0016	0.4302
199707-201410	1.2846	0.0017	0.9365	0.0017	0.4365
201411-201709	2.1558	0.0036	0.9628	0.0039	2.8859

	HK Three-Factor				
Period	GRS	$\|a\|$	R^2	s(a)	SR(a)
199707-201709	1.7940	0.0110	0.1497	0.0059	0.4597
199707-201410	1.4013	0.0103	0.1081	0.0064	0.4440
201411-201709	1.1359	0.0130	0.5848	0.0130	2.0242

	US Three-Factor				
Period	GRS	$\|a\|$	R^2	s(a)	SR(a)
199707-201709	1.8155	0.0113	0.0242	0.0064	0.4629
199707-201410	1.4395	0.0113	0.0113	0.0067	0.4501
201411-201709	0.9523	0.0067	0.1683	0.0188	1.889

	CN+HK Six-Factor				
Period	GRS	$\|a\|$	R^2	s(a)	SR(a)
199707-201709	1.4013	0.0018	0.9416	0.0016	0.4242
199707-201410	1.2428	0.0019	0.9500	0.0016	0.4363
201411-201709	1.8151	0.0039	0.9715	0.0039	3.6650

	CN+US Six Factor				
Period	GRS	$\|a\|$	R^2	s(a)	SR(a)
199707-201709	1.4367	0.0017	0.9405	0.0017	0.4295
199707-201410	1.3576	0.0020	0.9498	0.0016	0.4483
201411-201709	1.8426	0.0043	0.9706	0.004	3.7245

Table 6.1 gives the summary regression results of abnormal returns on 25 size-value sorted A- share portfolios. The table includes F-statistics of GRS test, average absolute value of intercepts, average R^2, average standard error of intercepts and the Sharp ratio of the intercepts in each set of regressions. To examine the level of integration, we choose three different period: July 1997 to September 2017, July 1997 to October 2014 and November 2014 to September 2017, corresponding to full sample since Hong Kong reunification, sample before Shanghai-Hong Kong Stock Connect and sample after Shanghai-Hong Kong Stock Connect.

Specifically, Sharp ratio of the intercepts ($SR(a)$), which is also the key among GRS test : $SR(a) = (a'E^{-1}a)^(1/2)$

Where a is the $25 * 1$ column vector of the abnormal returns under regressions on the 5*5 size-value sorted portfolios. E is the 25*25 variance-covariance matrix of residuals. $SR(a)$ takes both alpha and the variance-covariance matrix of residuals into consideration, which is helpful to capture the precision of intercepts in our models. Basically, $SR(a)$ is the Sharp ratio of the average unexplained returns of a model.

During July 1997 to September 2017, the local three-factor generates a GRS statistic of 1.4902, rejecting at the 95% level and an average absolute return of 0.18%. After replacing by Hong Kong and US factors separately, GRS statistic jumps to 1.7940 and 1.8155 and still cannot reject at the 95% level. However, the average absolute intercept also increased to 1.10% and 1.13%. GRS statistic shows an opposite way to shift before and after Shanghai-Hong Kong Stock Connect. Despite it rises before October 2014 but drops after November 2014, each value is under the 95% threshold, 2.66 and 2.92. Then we cannot reject the Hong Kong three-factor model and the US three-factor model in both sample periods.

In addition, the average absolute value of intercepts does not fall when employing global factors to explain A-share returns after November 2014 as in our hypothesis. It grows from 0.0036 to 0.013 and 0.0067 for Hong Kong and US factor model respectively. Actually, only regression results of abnormal return for big size portfolio (size 5) showed a decreased trend in both Hong Kong and US factor model after November 2014. It is reasonable to observe an incremental value of average absolute intercepts with all 25 size-B/M portfolios covered.

In terms of the goodness of fit, it is obvious that Hong Kong three-factor model provides larger average adjusted R^2 than US three-factor model. This, somewhat, indicates that Hong Kong factors can capture the excess returns of A-share portfolios in a better precision. As for results after Shanghai-Hong Kong Stock Connect, the average adjusted coefficient of determination for both two foreign factor models boosts to 0.5848 and 0.1683 compared with around 0.10 and 0.01 previously. On the other hand, the Sharp ratios of the intercept, produced by the world factor models, are slightly higher than those of domestic factor model except for sample period after November 2014. SR(a) performs extraordinarily and stays at a large number (2.8859, 2.0242 and 1.8890) from both country-specific and global versions. One explanation could be the limitation of sample. Since we only get 35 monthly excess returns but

for 25 portfolios from November 2014 to September 2017, the small sample size might have a negative impact on estimation of residuals in our model.

7 Conclusion

Our analysis draws several meaningful findings. First, we find that there is predictability of Chinese stock market return on latent variables which include common and local specific information. We also find that the conditional volatility and local price of risk are time varying for China. Price of risks for world market as well as China market are derived.

Unconditional multi-factor asset pricing model tests with global factors also yield positive results. Using Hong Kong and US risk factors with Fama-French 3-factor model, we are able to observe higher factor loadings across size and book-to-market sorted portfolios for Chinese market portfolios, implying certain degree of convergence of local and global factor pricing.

There are multiple possible extensions of our research. We incorporate change in foreign exchange rate as one of the instrument variables for estimating time varying local price of risk. A number of researchers have explicitly modeled foreign exchange risk as a standalone risk factor. From a cross-sectional perspective, new risk factors are gaining popularity among academia and practitioners. Our framework is flexible to incorporate an expanding set of risk factors and information.

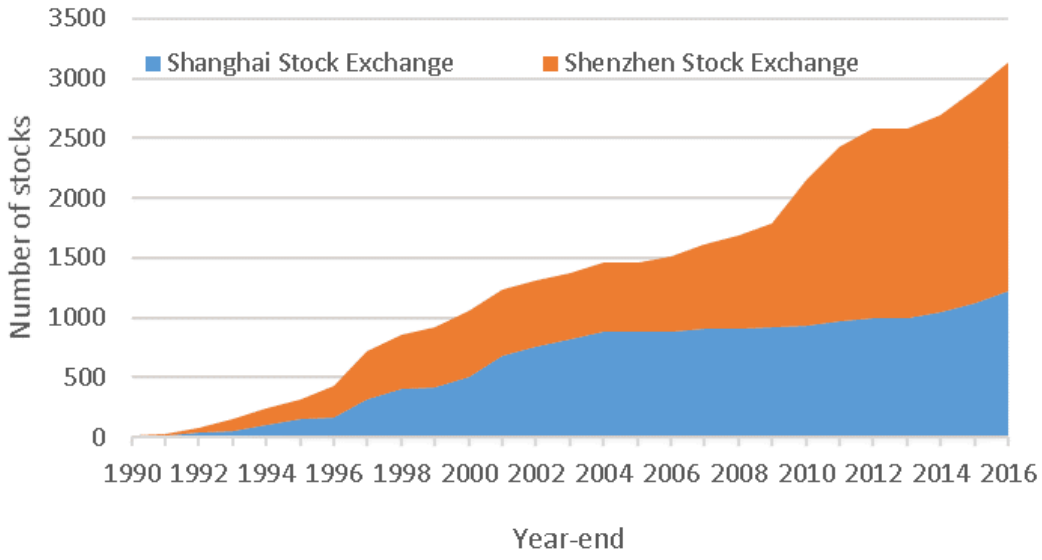
Moreover, the financial market integration of China itself is a topic interesting enough to deserve further research. The inclusion of Chinese A-Share into MSCI Indices symbolize the ongoing effort of the Chinese government to liberalize its financial market, creating opportunities for global investment community.

8 Appendix

8.1 Historical development of China's stock market

The Chinese equity market started from the opening of the Shanghai Stock Exchange in 1990 and the Shenzhen Stock Exchange in 1991. With only less than 10 firms listed in the both two exchanges, the total number of listed stocks and market capitalization achieved a fast growth in China for less than thirty years. Figure 2.1 gives a graphical representation of the total number of listed stocks and market capitalization from 1990 to 2016.

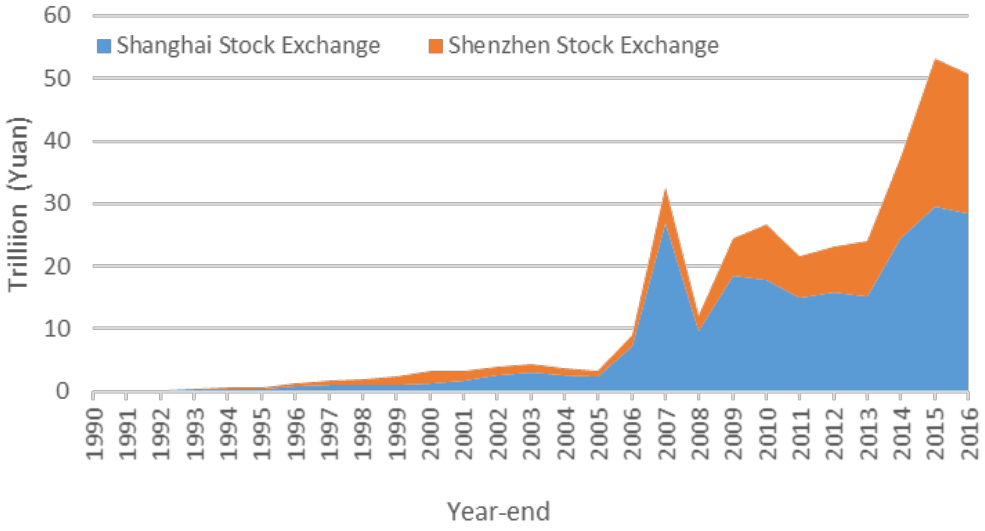
Figure 8.1: Number of Chinese Listed Stocks



In spite of the short history, the number of listed firms in China jumped from 14 at the beginning to 1,086 by the end of 2000, 2,063 by 2010 and 3,052 by 2016. Although these two exchanges share similarities in many aspects, there are differences in terms of

the target listed companies. In detail, the Small and Medium Enterprise(SME) board and the Growth Enterprise Market (GEM) board were introduced to the Shenzhen Stock Exchange respectively while only main board on the Shanghai Exchange. The listed firms on the Shenzhen Exchange are smaller in size but more in quantity. This fact offers an explanation for the less market capitalization of the Shenzhen exchange even with more listed stocks and various boards (three boards: main board, the SME board and the GEM board). Overall, the total market capitalization rose to around 54 trillion RMB (8.5 trillion USD) by the end of 2017, which is only second to the United States.

Figure 8.2: Total Stock Market Capitalization



8.2 Current situation of China's stock market

The China's stock market consists of three parts: A-share market, B-share market and H-share market. The official name of A-shares is renminbi (RMB) common stock. It refers to a common stock issued by a company within China for domestic investors to subscribe for and trade in RMB. The number of A shares reached 1642 by the end of 2016, which is a well-deserved representative of the Chinese stock market. B-shares

are denominated in RMB, but subscribed and traded in foreign currencies, usually in U.S. dollars on the Shanghai Stock Exchange and Hong Kong dollars on the Shenzhen Stock Exchange. The investors of B-shares stock are normally limited to foreigners or Chinese citizens residing in other countries. However, there are only 100 B-shares stocks traded on the Shanghai Stock Exchange and the Shenzhen Stock Exchange by the end of 2016. H-shares, traded in Hong Kong dollars, are the foreign-capital stocks which listed in the Hong Kong Stock Exchange but of firms registered in China Mainland.

Specifically, known as "split-share structure", A shares of one listed firm in China can be divided into two groups: "floating shares"and "non-floating shares". The floating shares refer to the shares could be circulated on exchange markets. On the contrary, non-floating shares usually owned by government and other legal entities, which cannot be traded freely on exchanges. Yet, they can be circulated in book value through auction or negotiating transfer after the approval from China Securities Regulatory Commission (CSRC). Actually, this split-share structure is the one of major obstacles to the stability and development of China's stock market. To the listed firms themselves, it is difficult to make acquisition or reorganization if non-floating shares exist. As for shareholders, there are many problems among relevant parties in the A-share market, such as uneven benefits, absolute control right under non-floating shareholders and the supply-demand imbalance in stock market. In the 2000s, the market capitalization of non-floating shares accounted for around two thirds of the total capitalization of China's stock market. Since 2005, CSRC has promoted "Full Circulation Reform" and started some trial implementations in certain companies. After a series of reform, this proportion decreased to 21% by the end of 2017. For this paper, we mainly do research based on data of floating A-shares, which can be easily traded for common domestic investors in China.

Based on a detailed breakdown of general legal entities, we normally classify investors in China's stock market into five categories : First, domestic professional institutional investors, including domestic public offering and private equity funds, securities, insurance, trusts, and other asset management agencies; second, industrial capital, including various industrial groups and their investment companies; and third, government holdings, i.e. direct holdings by government and some other

local state-owned operation platforms. The actual controllers of such shares are mostly representatives of state-owned investors; Fourth, individual investors, i.e., those directly involved in their personal names, including some individual major shareholders; fifth, overseas qualified institutional investors, mainly represented by QFII (Qualified Foreign Institutional Investor), RQFII(RMB Qualified Foreign Institutional Investors).

8.3 Differences between China and foreign stock markets

From the structure of investors' stock holding, here are three major differences between China and foreign stock markets. Firstly, professional investment sector in foreign countries has a relatively high proportion of stock market capitalization. Take American's stock market as an example, professional investors represented by mutual funds and pension funds, hold more than 40% of total market capitalization. Meanwhile, the number is only around 16% for China's A-share stock market by the end of 2016. There is huge room for Chinese professional investment institutions'growth in the future. Secondly, compared with developed equity market, China's stock market is less open and usually conducts more restrictions on overseas investors. In recent years, China has been promoting the financial market's openness especially the carrying out of Shanghai-Hong Kong Stock Connect and Shenzhen-Hong Kong Stock Connect. Additionally, MSCI announced the inclusion of China A shares into its key Emerging Markets and World indices in June 2017. Even though the percentage of overseas investors holding stocks is still low, at less than 1%, which is a big gap between China and developed markets. According to data of The People's Bank of China, the total amount of overseas institutions' and individuals' shareholding reached 1.02 trillion yuan in September 2017, marking the first breakthrough of 1 trillion yuan's investment abroad. Despite the low proportion, overseas qualified institutional investors hold securities for longer period and emphasize more on value investing.

Starting from November 2014, Shanghai-Hong Kong Stock Connect enables investors

both in Shanghai and Hong Kong to trade securities in each other's markets through the trading and clearing facilities on their home exchange. By April 2018, 894 stocks are included in Shanghai-Hong Kong Stock Connect. Then the similar Shenzhen-Hong Kong Stock Connect was also launched in December 2016, the scheme now covers over 2,000 eligible equities in Shanghai, Shenzhen and Hong Kong.

In general, Stock Connect is a pilot program established upon the Mutual Market Access model, is also a strategic breakthrough in the opening up of China's financial markets. In the future, based on success of Shanghai-Hong Kong Stock Connect, there might be Shanghai-United States Stock Connect and Shanghai-Europe Stock Connect to realize the overall collaboration between the China's stock market and the international stock market.

Table 8.1: Time-series regressions of A-shares excess returns of 25 size-B/M sorted portfolios on $R_M - R_f$,SMB and HML of the A-share market (July 1997 - October 2014)

For each of 25 portfolios, we run the following regression:

$$R_t^p - R_{f,t} = \alpha_p + \beta_p^M (R_{M,t} - R_{f,t}) + \beta_p^{SMB} SMB_t + \beta_p^{HML} HML_t + \varepsilon_t^p$$

Where $R_t^p - R_{f,t}$ is the excess return on the portfolio at month t, $R_{M,t} - R_{f,t}$ is the excess return on the market portfolio at month t, SMB_t is the return on a diversified portfolio of small stocks minus the return on a diversified portfolio of big stocks, HML_t is the difference between the returns on diversified portfolio of high and low B/M stocks and * ,** and *** indicate significance at the 0.1,0.05,0.01 levels respectively.

	B/M Quintile									
Size Quintile	Low	2	3	4	High	Low	2	3	4	High
	Portfolio excess return					Abnormal return:α^P				
Small	1.92**	2.34***	2.19***	2.05***	1.81**	0.0023	0.005**	0.005***	0.0032*	0.0005
	[2.69]	[3.22]	[3.11]	[2.93]	[2.6]	[0.87]	[2.68]	[3.21]	[1.9]	[0.32]
2	1.47**	1.71**	1.71**	1.71**	1.48**	0.0006	0.0027*	0.0015	0.0014	-0.0005
	[2.1]	[2.48]	[2.48]	[2.42]	[2.17]	[0.33]	[1.83]	[1.11]	[0.89]	[-0.29]
3	1.03	1.26*	1.3**	1.48**	1.14*	-0.0027	0	0.0004	0.001	-0.0008
	[1.56]	[1.92]	[1.96]	[2.2]	[1.71]	[-1.57]	[-0.02]	[0.23]	[0.61]	[-0.49]
4	0.85	0.90	1.07	0.96	1.01	-0.001	-0.0015	0.0003	-0.0008	-0.0001
	[1.39]	[1.36]	[1.57]	[1.49]	[1.56]	[-0.52]	[-0.81]	[0.17]	[-0.47]	[-0.05]
Big	0.48	0.44	0.66	0.65	0.49	0.0027*	-0.0001	0.0022	0.0019	0.0025
	[0.79]	[0.7]	[1.01]	[1.06]	[0.82]	[1.88]	[-0.05]	[1.19]	[1.14]	[1.55]
	Coefficient of $R_{M,t} - R_{f,t}$: β_P^M					Coefficients of SMB:β_P^{SMB}				
Small	0.9549***	0.9879***	0.9952***	0.9823***	0.9749***	1.1735***	1.2981***	1.1586***	1.1736***	1.1937***
	[31.7]	[45.54]	[55.17]	[50.08]	[55.1]	[17.64]	[27.09]	[29.07]	[27.09]	[30.54]
2	1.0063***	1.0362***	1.0154***	1.0505***	1.0108***	0.9107***	0.892***	1.0123***	0.9837***	0.927***
	[44.06]	[59.61]	[66.94]	[55.74]	[52.89]	[18.05]	[23.23]	[30.21]	[23.63]	[21.96]
3	0.984***	1.0056***	1.0267***	1.0236***	1.0448***	0.7885***	0.7234***	0.7072***	0.7885***	0.5995***
	[49.35]	[50.9]	[52.43]	[52.45]	[54.31]	[17.9]	[16.58]	[16.35]	[18.29]	[14.1]
4	0.9355***	1.0377***	1.0845***	1.0366***	1.0335***	0.4784***	0.5089***	0.4326***	0.4539***	0.3836***
	[41.32]	[46.93]	[49.9]	[53.56]	[50.96]	[9.57]	[10.42]	[9.01]	[10.62]	[8.56]
Big	0.9874***	1.0335***	1.0853***	1.0075***	0.9779***	-0.2547***	0.3836***	-0.184***	-0.1598***	-0.3792***
	[59.66]	[50.96]	[51.98]	[51.7]	[52.73]	[-6.97]	[8.56]	[-3.99]	[-3.71]	[-9.25]
	Coefficients of HML:β_P^{HML}					R^2				
Small	0.009	0.043	-0.0539	0.2117***	0.3373***	0.88	0.94	0.96	0.95	0.96
	[0.1]	[0.66]	[-0.99]	[3.58]	[6.33]					
2	-0.5247***	-0.1588***	0.0033	0.1245**	0.4596***	0.93	0.96	0.97	0.95	0.95
	[-7.63]	[-3.03]	[0.07]	[2.19]	[7.99]					
3	-0.2843***	-0.0702	-0.0254	0.282***	0.4816***	0.94	0.94	0.94	0.94	0.94
	[-4.74]	[-1.18]	[-0.43]	[4.8]	[8.31]					
4	-0.383***	-0.2012***	0.0537	0.1616***	0.6218***	0.91	0.92	0.93	0.94	0.93
	[-5.62]	[-3.02]	[0.82]	[2.77]	[10.18]					
Big	-0.8295***	0.6218***	0.1643**	0.5045***	0.6764***	0.95	0.93	0.93	0.93	0.94
	[-16.65]	[10.18]	[2.61]	[8.6]	[12.11]					

Table 8.2: Time-Series Regressions of A-shares Excess returns of 25 Size-B/M Sorted Portfolios on $R_M - R_f$, SMB and HML of the A-share market (November 2014 - September 2017)

	B/M Quintile									
Size Quintile	Low	2	3	4	High	Low	2	3	4	High
	Portfolio excess return					Abnormal return:α^P				
Small	3.38	2.96	3.16	3.22	2.62	0.0109*	0.0077*	0.009*	0.0091**	0.0049
	[1.49]	[1.32]	[1.29]	[1.37]	[1.27]	[1.69]	[1.83]	[1.78]	[2.3]	[1.25]
2	1.87	2.38	2.18	2.12	1.91	-0.0024	0.0038	0.0016	0.0006	-0.0008
	[0.84]	[1.03]	[1.04]	[1.06]	[0.98]	[-1.08]	[1.35]	[0.53]	[0.15]	[-0.16]
3	1.24	2.06	1.40	1.73	1.61	-0.0038	0.0024	-0.0032	-0.0007	-0.0006
	[0.59]	[0.93]	[0.69]	[0.9]	[0.97]	[-1.13]	[0.56]	[-0.88]	[-0.2]	[-0.19]
4	1.13	1.09	1.17	1.33	1.71	-0.0018	-0.0037	-0.0025	-0.0019	-0.0007
	[0.52]	[0.53]	[0.63]	[0.76]	[1.03]	[-0.4]	[-1]	[-0.7]	[-0.56]	[-0.18]
Big	0.77	1.31	1.42	1.55	1.58	0.0007	0.005	0.0028	0.004	0.0051
	[0.45]	[0.88]	[0.92]	[0.88]	[1.01]	[0.24]	[1.19]	[0.77]	[0.7]	[1.75]
	Coefficient of $R_{M,t} - R_{f,t}$: β_P^M					Coefficients of SMB:β_P^{SMB}				
Small	0.9347***	0.9594***	1.0406***	1.0475***	0.9369***	1.236***	1.1165***	1.1064***	1.1243***	1.0471***
	[12.61]	[19.84]	[17.88]	[22.92]	[20.6]	[6.28]	[8.7]	[7.16]	[9.26]	[8.67]
2	1.0956***	1.0644***	0.9851***	0.9939***	1.0209***	0.855***	0.8221***	0.8936***	0.8915***	0.78***
	[42.13]	[32.87]	[27.52]	[22.78]	[18.78]	[12.38]	[9.56]	[9.4]	[7.7]	[5.41]
3	1.0347***	1.0755***	1.0699***	1.0093***	0.9658***	0.4769***	0.6132***	0.4998***	0.6256***	0.4936***
	[26.9]	[21.31]	[25.73]	[23.48]	[25.11]	[4.67]	[4.58]	[4.53]	[5.48]	[4.83]
4	1.0715***	1.0413***	1.0573***	1.0601***	1.0584***	0.1663	0.3226**	0.188*	0.2414**	0.4152***
	[20.27]	[24.27]	[25.89]	[26.96]	[24.96]	[1.19]	[2.83]	[1.73]	[2.31]	[3.69]
Big	0.9976***	0.9146***	1.0294***	1.1677***	1.0053***	-0.3946***	-0.2508**	-0.1298	-0.3124*	-0.2986***
	[31.4]	[19.02]	[24.19]	[18.07]	[29.9]	[-4.68]	[-1.97]	[-1.15]	[-1.82]	[-3.34]
	Coefficients of HML:β_P^{HML}							R^2		
Small	-0.1389	-0.2883*	-0.4803**	-0.3077**	-0.1234	0.93	0.97	0.97	0.98	0.97
	[-0.6]	[-1.9]	[-2.62]	[-2.14]	[-0.86]					
2	-0.3513***	-0.6404***	-0.3213***	-0.0639	-0.0424	0.99	0.99	0.98	0.97	0.95
	[-4.3]	[-6.29]	[-2.86]	[-0.47]	[-0.25]					
3	-0.7977***	-0.6838***	-0.5428***	-0.2594**	0.0438	0.98	0.97	0.97	0.97	0.97
	[-6.6]	[-4.31]	[-4.15]	[-1.92]	[0.36]					
4	-1.2207***	-0.9074***	-0.5592***	-0.2035*	0.5161***	0.96	0.97	0.97	0.97	0.96
	[-7.34]	[-6.73]	[-4.36]	[-1.65]	[3.87]					
Big	-1.2445***	-0.691***	-0.1613	-0.1143	0.6543***	0.98	0.94	0.95	0.92	0.97
	[-12.46]	[-4.57]	[-1.21]	[-0.56]	[6.19]					

Table 8.3: Time-Series Regressions of A-shares Excess returns of 25 Size-B/M Sorted Portfolios on $R_M - R_f$, SMB and HML of HK Stock market (July 1997 - October 2014)

	B/M Quintile									
Size Quintile	Low	2	3	4	High	Low	2	3	4	High
	Portfolio excess return					Abnormal return:α^P				
Small	1.92**	2.34***	2.19***	2.05***	1.81**	0.0167**	0.0212***	0.0198***	0.0183**	0.0156**
	[2.69]	[3.22]	[3.11]	[2.93]	[2.6]	[2.46]	[3.03]	[2.94]	[2.71]	[2.35]
2	1.47**	1.71**	1.71**	1.71**	1.48**	0.0132**	0.0148**	0.0148**	0.0148**	0.0121*
	[2.1]	[2.48]	[2.48]	[2.42]	[2.17]	[2.01]	[2.23]	[2.26]	[2.17]	[1.86]
3	1.03	1.26*	1.3**	1.48**	1.14*	0.0083	0.0102	0.0105*	0.0121*	0.0083
	[1.56]	[1.92]	[1.96]	[2.2]	[1.71]	[1.31]	[1.63]	[1.65]	[1.9]	[1.3]
4	0.85	0.90	1.07	0.96	1.01	0.0063	0.0066	0.0077	0.0068	0.0071
	[1.39]	[1.36]	[1.57]	[1.49]	[1.56]	[1.09]	[1.06]	[1.21]	[1.11]	[1.15]
Big	0.48	0.44	0.66	0.65	0.49	0.0026	0.0016	0.0032	0.0034	0.0011
	[0.79]	[0.7]	[1.01]	[1.06]	[0.82]	[0.44]	[0.26]	[0.52]	[0.57]	[0.19]
	Coefficient of $R_{M,t} - R_{f,t}$: β_P^M					Coefficients of SMB:β_P^{SMB}				
Small	0.2289**	0.2355**	0.2453***	0.214**	0.2301**	0.5352***	0.4918***	0.4813***	0.4593***	0.5017***
	[2.62]	[2.62]	[2.83]	[2.46]	[2.69]	[4.21]	[3.77]	[3.82]	[3.64]	[4.04]
2	0.2757***	0.266***	0.2795***	0.2309**	0.2363***	0.5779***	0.4176***	0.4751***	0.4635***	0.48***
	[3.28]	[3.11]	[3.32]	[2.63]	[2.82]	[4.73]	[3.36]	[3.88]	[3.63]	[3.94]
3	0.2236**	0.2226**	0.263***	0.237***	0.2722***	0.4193***	0.4676***	0.4085***	0.5089***	0.3924***
	[2.74]	[2.75]	[3.2]	[2.89]	[3.32]	[3.53]	[3.98]	[3.42]	[4.27]	[3.3]
4	0.2445***	0.236***	0.2833***	0.2636***	0.2484***	0.4733***	0.4915***	0.4652***	0.4339***	0.4421***
	[3.31]	[2.91]	[3.43]	[3.33]	[3.12]	[4.41]	[4.18]	[3.88]	[3.77]	[3.83]
Big	0.255***	0.3254***	0.3174***	0.2421***	0.3208***	0.3525***	0.3131***	0.3311***	0.2326**	0.2578**
	[3.41]	[4.21]	[3.99]	[3.18]	[4.42]	[3.24]	[2.79]	[2.87]	[2.1]	[2.44]
	Coefficients of HML:β_P^{HML}					R^2				
Small	0.0941	0.0352	0.0082	0.0686	0.0966	0.12	0.1	0.11	0.1	0.12
	[0.6]	[0.22]	[0.05]	[0.44]	[0.63]					
2	-0.158	0.0433	0.0184	0.0752	0.1306	0.15	0.1	0.13	0.1	0.12
	[-1.05]	[0.28]	[0.12]	[0.48]	[0.87]					
3	0.0223	0.094	0.0868	0.129	0.2059	0.1	0.12	0.11	0.13	0.12
	[0.15]	[0.65]	[0.59]	[0.88]	[1.41]					
4	0.0433	0.0777	0.1321	0.1348	0.1902	0.14	0.13	0.14	0.13	0.13
	[0.33]	[0.54]	[0.9]	[0.96]	[1.34]					
Big	0.0492	0.0912	0.1974	0.2579*	0.3012**	0.11	0.13	0.13	0.1	0.16
	[0.37]	[0.66]	[1.39]	[1.9]	[2.33]					

Table 8.4: Time-Series Regressions of A-shares Excess returns of 25 Size-B/M Sorted Portfolios on $R_M - R_f$, SMB and HML of the HK stock market (November 2014 - September 2017)

	B/M Quintile									
Size Quintile	Low	2	3	4	High	Low	2	3	4	High
	Portfolio excess return					Abnormal return:α^P				
Small	3.38	2.96	3.16	3.22	2.62	0.0308**	0.0257	0.028**	0.0295	0.0228
	[1.49]	[1.32]	[1.29]	[1.37]	[1.27]	[2.1]	[1.54]	[1.75]	[1.99]	[1.56]
2	1.87	2.38	2.18	2.12	1.91	0.0147	0.0194	0.0177	0.0159	0.0132
	[0.84]	[1.03]	[1.04]	[1.06]	[0.98]	[1]	[1.29]	[1.26]	[1.22]	[1.02]
3	1.24	2.06	1.40	1.73	1.61	0.0079	0.0158	0.0078	0.0116	0.0093
	[0.59]	[0.93]	[0.69]	[0.9]	[0.97]	[0.56]	[1.12]	[0.59]	[0.95]	[0.9]
4	1.13	1.09	1.17	1.33	1.71	0.0071	0.0063	0.0053	0.0059	0.0083
	[0.52]	[0.53]	[0.63]	[0.76]	[1.03]	[0.48]	[0.46]	[0.43]	[0.55]	[0.77]
Big	0.77	1.31	1.42	1.55	1.58	0.0011	0.006	0.0054	0.0045	0.0054
	[0.45]	[0.88]	[0.92]	[0.88]	[1.01]	[0.1]	[0.64]	[0.53]	[0.42]	[0.49]
	Coefficient of $R_{M,t} - R_{f,t}$: β_P^M					Coefficients of SMB:β_P^{SMB}				
Small	1.2396***	1.2786***	1.3931***	1.2848***	1.1806***	1.5112***	1.17***	1.5586***	1.6169***	1.1877***
	[4.23]	[3.84]	[4.35]	[4.31]	[4.03]	[4.82]	[3.28]	[4.55]	[5.07]	[3.79]
2	1.2757***	1.4235***	1.2333***	1.3394***	1.2821***	1.3687***	1.3596***	1.2449***	1.0431***	1.0107***
	[4.35]	[4.71]	[4.37]	[5.15]	[4.96]	[4.36]	[4.21]	[4.12]	[3.75]	[3.66]
3	1.3252***	1.4266***	1.4485***	1.288***	1.2468***	1.1514***	1.2613***	0.9921***	1.0075***	0.7041***
	[4.65]	[5.03]	[5.53]	[5.24]	[6.04]	[3.78]	[4.16]	[3.54]	[3.83]	[3.19]
4	1.3675***	1.3274***	1.3221***	1.2941***	1.2684***	1.1782***	1.1148***	0.7677***	0.7342***	0.4869**
	[4.59]	[4.79]	[5.3]	[5.99]	[5.83]	[3.7]	[3.76]	[2.88]	[3.18]	[2.09]
Big	1.3303***	1.202***	1.2204***	1.362***	1.0112***	0.6865***	0.4633*	0.3575	0.3638	0.0593
	[6.1]	[6.4]	[6.05]	[6.37]	[4.58]	[2.94]	[2.31]	[1.66]	[1.59]	[0.25]
	Coefficients of HML:β_P^{HML}					R^2				
Small	-0.6802	-1.0139	-0.957	-0.8942	-0.8382	0.64	0.52	0.63	0.65	0.56
	[-0.96]	[-1.26]	[-1.24]	[-1.24]	[-1.19]					
2	-0.5812	-1.0221	-0.5977	-0.7275	-0.1786	0.62	0.63	0.6	0.63	0.62
	[-0.82]	[-1.4]	[-0.88]	[-1.16]	[-0.29]					
3	-0.9169	-0.9846	-0.7554	-0.3594	-0.1639	0.6	0.64	0.64	0.64	0.66
	[-1.33]	[-1.44]	[-1.2]	[-0.61]	[-0.33]					
4	-1.1978*	-0.9208	-0.6152	0.0271	0.4589	0.59	0.61	0.6	0.66	0.63
	[-1.67]	[-1.38]	[-1.02]	[0.05]	[0.87]					
Big	-0.6475	-0.2432	0.4731	1.052**	1.6537***	0.65	0.65	0.63	0.67	0.56
	[-1.23]	[-0.54]	[0.97]	[2.04]	[3.1]					

Table 8.5: Time-Series Regressions of A-shares Excess returns of 25 Size-B/M Sorted Portfolios on $R_M - R_f$, SMB and HML of the U.S. stock market (July 1997 - October 2014)

	B/M Quintile									
Size Quintile	Low	2	3	4	High	Low	2	3	4	High
	Portfolio excess return					Abnormal return:α^P				
Small	1.92**	2.34***	2.19***	2.05***	1.81**	0.0183**	0.0222***	0.0206***	0.0192**	0.0167**
	[2.69]	[3.22]	[3.11]	[2.93]	[2.6]	[2.56]	[3.05]	[2.9]	[2.73]	[2.39]
2	1.47**	1.71**	1.71**	1.71**	1.48**	0.0133*	0.0157**	0.0154**	0.0158**	0.0134*
	[2.1]	[2.48]	[2.48]	[2.42]	[2.17]	[1.89]	[2.26]	[2.23]	[2.22]	[1.94]
3	1.03	1.26*	1.3**	1.48**	1.14*	0.0089	0.0111*	0.0116*	0.0131*	0.0096
	[1.56]	[1.92]	[1.96]	[2.2]	[1.71]	[1.35]	[1.67]	[1.73]	[1.94]	[1.43]
4	0.85	0.90	1.07	0.96	1.01	0.0069	0.0076	0.0089	0.0081	0.0083
	[1.39]	[1.36]	[1.57]	[1.49]	[1.56]	[1.12]	[1.14]	[1.31]	[1.24]	[1.27]
Big	0.48	0.44	0.66	0.65	0.49	0.003	0.0022	0.0046	0.0046	0.0024
	[0.79]	[0.7]	[1.01]	[1.06]	[0.82]	[0.5]	[0.34]	[0.7]	[0.75]	[0.4]
	Coefficient of $R_{M,t} - R_{f,t}$: β_P^M					Coefficients of SMB:β_P^{SMB}				
Small	0.362**	0.3789**	0.2921*	0.3232**	0.3121**	-0.2796	-0.2326	-0.0182	-0.1128	-0.0796
	[2.26]	[2.33]	[1.84]	[2.05]	[1.99]	[-1.19]	[-0.97]	[-0.08]	[-0.49]	[-0.35]
2	0.2526	0.3788**	0.3267**	0.3088*	0.3105**	0.0734	-0.1424	0.0145	-0.1061	-0.0699
	[1.61]	[2.45]	[2.11]	[1.94]	[2.02]	[0.32]	[-0.63]	[0.06]	[-0.45]	[-0.31]
3	0.3084**	0.2859*	0.3148**	0.311**	0.2948**	-0.0536	0.0248	-0.0396	0.0131	0.0559
	[2.08]	[1.93]	[2.1]	[2.06]	[1.98]	[-0.25]	[0.11]	[-0.18]	[0.06]	[0.25]
4	0.2968**	0.2722*	0.3017**	0.2821*	0.3292**	0.0398	0.0207	0.0648	0.0409	0.0285
	[2.17]	[1.83]	[1.98]	[1.93]	[2.25]	[0.2]	[0.09]	[0.29]	[0.19]	[0.13]
Big	0.2646*	0.3143**	0.3481**	0.3488**	0.3436**	0.1676	0.2103	0.0745	0.0215	0.225
	[1.95]	[2.23]	[2.39]	[2.55]	[2.57]	[0.84]	[1.01]	[0.35]	[0.11]	[1.14]
	Coefficients of HML:β_P^{HML}							R^2		
Small	-0.0833	-0.0794	-0.0775	-0.0409	-0.0282	0.03	0.03	0.02	0.02	0.02
	[-0.48]	[-0.45]	[-0.46]	[-0.24]	[-0.17]					
2	-0.106	-0.0328	-0.0316	0.0209	0.0302	0.02	0.03	0.02	0.02	0.02
	[-0.63]	[-0.2]	[-0.19]	[0.12]	[0.18]					
3	-0.0606	0.0011	-0.0278	0.0171	0.0743	0.02	0.02	0.02	0.02	0.02
	[-0.38]	[-0.01]	[-0.17]	[0.11]	[0.46]					
4	-0.0158	-0.0332	0.012	-0.0164	0.0148	0.03	0.02	0.02	0.02	0.03
	[-0.11]	[-0.21]	[0.07]	[-0.1]	[0.09]					
Big	-0.0623	0.0001	-0.0238	0.0235	0.0588	0.03	0.04	0.03	0.04	0.05
	[-0.43]	[0]	[-0.15]	[0.16]	[0.41]					

Table 8.6: Time-Series Regressions of A-shares Excess returns of 25 Size-B/M Sorted Portfolios on $R_M - R_f$, SMB and HML of the U.S. stock market (November 2014 - September 2017)

	B/M Quintile									
Size Quintile	Low	2	3	4	High	Low	2	3	4	High
	Portfolio excess return					Abnormal return:α^P				
Small	3.38	2.96	3.16	3.22	2.62	0.0209	0.0148	0.0165	0.0179	0.0134
	[1.49]	[1.32]	[1.29]	[1.37]	[1.27]	[0.92]	[0.68]	[0.68]	[0.76]	[0.67]
2	1.87	2.38	2.18	2.12	1.91	0.0041	0.0076	0.0083	0.007	0.0051
	[0.84]	[1.03]	[1.04]	[1.06]	[0.98]	[0.19]	[0.34]	[0.41]	[0.37]	[0.28]
3	1.24	2.06	1.40	1.73	1.61	-0.0037	0.0064	-0.0013	0.0031	0.0031
	[0.59]	[0.93]	[0.69]	[0.9]	[0.97]	[-0.18]	[0.29]	[-0.07]	[0.17]	[0.2]
4	1.13	1.09	1.17	1.33	1.71	-0.0029	-0.0047	-0.0031	-0.0009	0.0047
	[0.52]	[0.53]	[0.63]	[0.76]	[1.03]	[-0.14]	[-0.24]	[-0.18]	[-0.06]	[0.31]
Big	0.77	1.31	1.42	1.55	1.58	-0.0064	0.0006	0.0012	0.0033	0.0071
	[0.45]	[0.88]	[0.92]	[0.88]	[1.01]	[-0.4]	[0.05]	[0.09]	[0.19]	[0.46]
	Coefficient of $R_{M,t} - R_{f,t}$: β_P^M					Coefficients of SMB:β_P^{SMB}				
Small	1.562**	1.7767**	1.8121**	1.7193**	1.5226**	0.2301	0.8049	0.5072	0.6514	0.9367
	[2.03]	[2.44]	[2.22]	[2.19]	[2.25]	[0.22]	[0.81]	[0.46]	[0.61]	[1.02]
2	1.7535**	1.9393**	1.6216**	1.7001**	1.6848**	0.5848	0.6899	0.7342	0.797	0.871
	[2.41]	[2.6]	[2.37]	[2.68]	[2.72]	[0.59]	[0.68]	[0.79]	[0.92]	[1.03]
3	1.9371***	1.7011**	1.835***	1.7084***	1.5575***	0.4131	0.6946	0.7071	0.6594	0.7303
	[2.89]	[2.34]	[2.85]	[2.81]	[3.06]	[0.45]	[0.7]	[0.81]	[0.8]	[1.06]
4	1.699**	1.8736***	1.7586***	1.7047***	1.491***	0.7493	0.6828	0.8509	0.7093	0.9421
	[2.39]	[2.87]	[3.15]	[3.22]	[2.94]	[0.77]	[0.77]	[1.12]	[0.99]	[1.37]
Big	1.6961***	1.4874***	1.5605***	1.4745**	1.0653**	0.2718	0.7087	0.6948	0.4522	0.3459
	[3.15]	[3.38]	[3.39]	[2.62]	[2.07]	[0.37]	[1.18]	[1.11]	[0.59]	[0.49]
	Coefficients of HML:β_P^{HML}					R^2				
Small	0.2292	-0.1837	-0.178	-0.2763	-0.3323	0.14	0.21	0.17	0.17	0.2
	[0.31]	[-0.26]	[-0.22]	[-0.36]	[-0.51]					
2	-0.1647	-0.3183	-0.0939	-0.2121	-0.2488	0.2	0.22	0.21	0.25	0.26
	[-0.23]	[-0.44]	[-0.14]	[-0.35]	[-0.42]					
3	-0.2825	-0.3771	-0.3644	-0.2976	-0.1892	0.24	0.19	0.26	0.25	0.3
	[-0.43]	[-0.54]	[-0.58]	[-0.51]	[-0.38]					
4	-0.5873	-0.5121	-0.4527	-0.2793	-0.1276	0.2	0.26	0.31	0.31	0.31
	[-0.85]	[-0.81]	[-0.84]	[-0.55]	[-0.26]					
Big	-0.3825	-0.436	-0.1887	0.0517	0.3882	0.27	0.34	0.34	0.23	0.19
	[-0.73]	[-1.02]	[-0.42]	[0.09]	[0.78]					

Table 8.7: Time-Series Regressions of A-shares Excess returns of 25 Size-B/M Sorted Portfolios on $R_M - R_f$, SMB and HML of the A-share stock market (January 2008 - September 2017)

	B/M Quintile									
Size Quintile	Low	2	3	4	High	Low	2	3	4	High
	Portfolio excess return					Abnormal return:α^P				
Small	2.27**	2.51**	2.46**	2.3**	1.98**	0.0049	0.0072***	0.0065**	0.0051**	0.002
	[2.2]	[2.38]	[2.32]	[2.16]	[1.99]	[1.62]	[3.04]	[2.62]	[2.47]	[0.92]
2	1.40	1.66	1.67	1.56	1.45	-0.0012	0.0014	0.0002	-0.0004	-0.0004
	[1.35]	[1.6]	[1.66]	[1.53]	[1.48]	[-0.63]	[0.71]	[0.08]	[-0.17]	[-0.16]
3	1.20	1.24	1.31	1.36	0.97	0.0001	-0.001	0.0008	0.001	-0.0004
	[1.2]	[1.22]	[1.35]	[1.41]	[1.04]	[0.04]	[-0.46]	[0.35]	[0.46]	[-0.2]
4	0.78	0.72	0.94	0.66	0.51	-0.0013	-0.003	0.0004	-0.0013	-0.0014
	[0.79]	[0.74]	[0.96]	[0.71]	[0.56]	[-0.54]	[-1.34]	[0.18]	[-0.63]	[-0.62]
Big	0.21	0.23	-0.02	0.39	-0.02	0.0021	0.0012	-0.0005	0.004	0.0028
	[0.26]	[0.27]	[-0.02]	[0.45]	[-0.02]	[0.77]	[0.53]	[-0.26]	[1.56]	[1.64]
	Coefficient of $R_{M,t} - R_{f,t}$: β_P^M					Coefficients of SMB:β_P^{SMB}				
Small	0.9561***	0.9969***	0.9896***	1.0335***	0.9582***	1.2069***	1.2081***	1.2239***	1.2119***	1.2351***
	[28.14]	[37.6]	[35.72]	[44.52]	[39.91]	[12.85]	[16.48]	[15.98]	[18.88]	[18.61]
2	1.0432***	1.0287***	0.9904***	1.034***	1.0099**	0.9916***	0.9917***	1.1197***	1.088***	1.0133***
	[50.29]	[47.25]	[45.84]	[42.74]	[39.95]	[17.29]	[16.48]	[18.75]	[16.27]	[14.5]
3	1.0168***	1.0492***	1.0212***	1.0199***	1.0367***	0.7258***	0.8612***	0.7954***	0.8258***	0.6624***
	[37.8]	[41.27]	[41.96]	[41.62]	[45.92]	[9.76]	[12.25]	[11.82]	[12.19]	[10.61]
4	1.0133***	1.0346***	1.0975***	1.0545***	1.0463***	0.5013***	0.6015***	0.5454***	0.4752***	0.4175***
	[35.93]	[41.39]	[45.3]	[45.21]	[41.16]	[6.43]	[8.7]	[8.14]	[7.37]	[5.94]
Big	0.9604***	1.0399***	1.0367***	1.0343***	1.0161***	-0.1788**	-0.057	-0.073	-0.0916	-0.25***
	[30.23]	[40.75]	[45.3]	[35.69]	[53.6]	[-2.12]	[-0.81]	[-1.15]	[-1.14]	[-4.77]
	Coefficients of HML:β_P^{HML}					R^2				
Small	-0.0732	-0.1361	-0.1897	-0.0909	0.1731**	0.93	0.96	0.96	0.97	0.96
	[-0.65]	[-1.54]	[-2.05]	[-1.17]	[2.16]					
2	-0.2996***	-0.3111***	-0.0529	0.1182	0.2254**	0.97	0.97	0.97	0.96	0.96
	[-4.33]	[-4.28]	[-0.73]	[1.46]	[2.67]					
3	-0.5695***	-0.3304***	-0.2055**	-0.0103	0.2491***	0.95	0.96	0.96	0.96	0.96
	[-6.34]	[-3.9]	[-2.53]	[-0.13]	[3.31]					
4	-0.8225***	-0.5294***	-0.1327	-0.0364	0.4577***	0.95	0.96	0.96	0.96	0.95
	[-8.74]	[-6.35]	[-1.64]	[-0.47]	[5.4]					
Big	-0.9835***	-0.4457***	0.0123	0.2312**	0.7316***	0.95	0.94	0.95	0.93	0.97
	[-9.85]	[-5.23]	[0.16]	[2.39]	[11.57]					

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