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A comparison of the efficacy of liquidity, momentum, size and book-to-market value factors in equity pricing on a heterogeneous sample: Evidence from Asia

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Abstract

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1. Introduction

The capital asset pricing model (CAPM) has generated a considerable literature since its initial formulation by Sharpe (1964) and Lintner (1965) with the basic single factor model being extended through its augmentation with additional valuation factors purporting to enhance its ability to explain the cross section of stock returns in a given universe. These typically include returns-based factors capturing cross sectional differences in size and accounting book to market value (Fama and French, 1993), momentum (Jegadeesh and Titman, 1993, 2001) and more recently liquidity (Pastor and Stambaugh, 2003; Liu, 2006). An individual stock or portfolio's association with these aggregate factors is then simply interpreted as their coefficients in a time series regression (Black, Jensen and Scholes, 1972) where the model intercepts or alphas are expected to be zero (Merton, 1973). The inclusion of such additional factors within an extended CAPM based framework is subject to debate with adherents arguing of the impact on investor welfare arising from these necessitating compensatory premiums to be attributed to these underlying factors (see Liu, 2006 for detailed discussion). On the contrary authors such as Lakonishok et al (1994), Daniel and Titman (1997) and Daniel et al (2001) assert that such pricing anomalies associated with these factors are related to inefficiencies in the way markets incorporate information into equity prices. Despite this controversy there is a general consensus regarding the importance of additional factors within a multifactor format – be this expressed through an intertemporal capital asset pricing model (ICAPM) of Merton (1973) or the arbitrage pricing model format of Ross (1976). However the question of whether equities priced with these factors are better priced using local domestic or international market universes is enduring (see Karolyi and Stulz, 2003). This is due to unresolved quandaries over segmentation given the fundamental importance of notions of asset market integration that underscore asset pricing theory. As such we are motivated to differentiate between contrasting multifactor asset pricing models yielding varying explanatory power of the cross section of stock returns while taking account of inherent segmentation within multi-country universes.

Recent research testing the efficacy of asset pricing models within the context of segmentation has been undertaken by Hou et al (2010). This focussed on the differentiation

between contrasting multifactor asset pricing models formed through the augmentation of single factor CAPM with Fama and French (1993) size and book-to-market value alongside a variety of cash-flow factors between individual domestic universes and a global counterpart formed from the 49 constituent markets. A key limitation in the employment of an array of factors based on firm's cash flow balance sheet items is the availability of data within a broader emerging economy sample, such as across a wider Asian regional universe. Furthermore a body of recent research suggests liquidity to be a likely candidate factor for consideration in standard asset pricing models. Pastor and Stambaugh (2003) develop a multifactor pricing model including a simple volume-based liquidity metric while Liu (2006) finds evidence that a two factor liquidity augmented CAPM better explains the cross section of stock returns than either the unitary CAPM or the Fama and French (1993) three factor (henceforth FF3F) models. Furthermore Jagadeesh and Titman (1993, 2001) find evidence of price-based momentum performance factor in yielding robust explanation of cross section of stock returns while Carhart (1997) further developed this into the joint inclusion of momentum factor on top of FF3F. A principal limitation in all these studies is their almost exclusive focus on the single country setting of US equity market. Following on from these developments our first contribution to the literature on application of pricing models within a multi-country setting is in the differentiation between single factor CAPM to its augmented counterparts where these are based on FF3F, Carhart (1997) four factor (4F) augmenting FF3F with momentum, and two factor liquidity models of Liu (2006) where these use two rival liquidity factors: one based on an annual rebalancing and holding period, and the other based on monthly rebalancing.

Our second contribution to the literature arises from our relaxing the time-invariant constraints on parameters estimated within standard multi-factor augmented CAPM frameworks and allowing for parameter coefficients to stochastically vary over the duration of sample period. This follows a number of applied studies using such time varying parameter asset pricing models based on Kalman filter such as Brooks et al (1998) in studying a sample of Australian industry portfolios, and Hearn (2010) studying four South Asian equity markets, namely India, Pakistan, Bangladesh and Sri Lanka. These studies are generally constrained in terms of sample time frames

and geographic scope. Consequently our use of Kalman filter time varying parameter methods is an attempt in implicitly taking account of intra-sample segmentation (both intra and inter-market) within a universe and structural breaks in underlying data series. Furthermore our application of such methods across a broad and comprehensive Asian sample alongside sub-samples based on single country (multiple market) of Japan and Asia-excluding Japan is an explicit attempt in taking account of segmentation.

Our geographic focus on the Asian region is largely justified by this region being a centre to a large, well developed investment management industry primarily centred on the developed markets of Singapore, Hong Kong, Japan and Australia while the region itself is broad with national markets ranging from amongst the smallest worldwide (e.g. Maldives, Laos and Cambodia) to some of the largest (such as Tokyo, Singapore and Hong Kong). It is also institutionally diverse with prominent religions including Orthodox Christianity (Armenia), Islam (Maldives, Pakistan, Bangladesh and Indonesia), Hindu (India), and Buddhist (Thailand, Laos, Cambodia) while many societies informal institutional structure is communitarian and feudal in nature centring on extended familial groups (Claessens et al, 2000). Formal institutions are almost invariably inherited from European colonial metropoles where these provide the institutional frameworks supporting the establishment and sustainability of stock markets – including their regulation, accounting and reporting standards and the enforcement of these. Thus this region provides an excellent laboratory for the study of segmentation and optimal choice of valuation factors for inclusion in multifactor pricing models.

Our findings reveal very little statistical support for time-invariant asset pricing models in general. The expectation of regression intercepts equalling zero is violated to a high degree as is evident from extremely high F-statistics arising from application of Gibbons, Ross and Shanken (1989) (henceforth GRS) statistical test to ascertain likelihood of the intercepts from a number of test asset portfolios jointly being equal to zero. The extremely high value of F-statistics also precludes the use of such GRS methods as a means to differentiate between rival multifactor models. This very high level of rejection of time invariant parameter models is also a prominent feature of

literature with similar results reported by Fama and French (1993) in US market and Hou et al (2011) in a global study of 49 countries. However in contrast the application of Kalman filter time varying parameter methodology to augmented multifactor CAPM framework points towards the efficacy in information criterion terms (Aikaike Information Criterion, AIC) of two factor liquidity augmented CAPM – with the liquidity factor being that of the 1 year rebalanced and 1 year holding factor. Finally we find very little evidence of a priced momentum factor with this almost wholly lacking statistical significance in a time-invariant context while models including this in a time-varying context have generally lower AIC information criterions. This is in contrast to the evidence of Rouwenhorst (1998) and Griffin et al (2003) where some support for this factor was found in international samples.

We proceed as follows. The next section outlines the institutional differences across the Asian region and the implications arising from these on liquidity – an important state variable central to our study – and then elaborates on the liquidity metric we use (namely that of Liu, 2006). Section 3 outlines data procurement and sample universe formation alongside a detailed elaboration of factor mimicking portfolio construction. Section 4 outlines the time invariant parameter and time-varying models while section 5 details the empirical results. The final section concludes.

2. Institutional arrangements supporting stock markets across Asia

2.1 Institutional arrangements

Asia's informal institutions are generally communalistic and communitarian in nature with this commonly reflected in a propensity of feudalistic systems centred on large extended families and clans (Claessens et al, 2000). The communitarian nature of societies is also reinforced through the dominant religions across the region with these being Islam (see Kuran (2005) for discussion of communitarian nature of Islam), Buddhist and Taoist, Hindu and both Orthodox Christian (Armenia) and Roman Catholic (Philippines). However all countries across the region, with sole exception of Thailand and Japan, inherited formal institutions from former European colonial metropoles, while Thailand extensively borrowed English common law governance institutions from neighbouring

Malaysia and Japan actively sought the reformation of its indigenous governance institutions at the turn of 19th century thus transplanting European and mostly German civil code law institutions (DiMaggio and Powell, 1983; La Porta et al, 2008). This is also evident from the first column in Table 1. A fundamental part of this transplantation of European origin institutions has been the absorption of indigenous Asian societies of both formal Western state governance structures alongside as well as the assimilation of additional institutional structures such as the Western organizational definition of the corporation (Kuran, 2009). This entails not only the notion of joint-stock company but also related notions of double entry accounting book keeping, limited liability, minority investor property rights (Kuran, 2009) and firm governance structures closely related to the choice of finance: be this equity or debt, internal or external, relationship-orientated bank or external capital market.

Table 1

Modern financial institutions, such as banks and capital markets are wholly dependent themselves on equitable government regulation and prudent supervisory authorities. Furthermore their establishment is often the result of either coercive isomorphic institutional pressure, through concerted action of colonial metropoles or more recently through actions by international financial institutions IMF, World Bank and regional development banks), such as structural adjustment programs, or through mimetic isomorphic institutional pressures by indigenous public sectors and states seeking to alleviate uncertainty through the adoption of well recognized structures that maintain conformity (amongst competing states worldwide) in structure of formal economic and political apparatus. This conformity or standardization is particularly important in states, and financial sectors established or reformed by the state, competing for scarce foreign portfolio and direct investment. An immediate consequence of this conformity drive in the adoption of Western formal institutions has been the establishment of stock markets across the Asian region as well as the universal adoption of Western corporate organizational form. However the degree of successful assimilation of these into the deeper sociologically defined informal institutions within indigenous

societies varies considerably across Asia. This differential in adoption and adaption is equally reflected in varying levels of regulation and surveillance, differences in accounting standards and auditing as well as legal and regulatory enforcement of standards. Collectively these issues define varying transactions costs between and within equity markets across the region. Transactions costs are themselves reflected in liquidity (Liu, 2006; Pastor and Stambaugh, 2003)

These differences in regulation and supervision are evident in column 2 of Table 1. Here detail is provided of the regulatory and supervisory structures in place across Asia where these vary from regulatory oversight provided by central banks in countries such as Philippines, Fiji, Vietnam and Armenia to dedicated securities and exchange commissions in countries such as Malaysia, Singapore, South Korea, and Australia and New Zealand. Formal government Ministries of Finance also have supervisory duties as in the case of Indonesia, China, Cambodia and India which is a more direct link into the political apparatus of indigenous nation states.

Differences in permissible separation of ownership from control (as achieved through ownership diversification) are visible across the region in columns 3 and 4 of Table 1. These detail the listing requirements for all equity markets and reveal substantial differences ranging from minimum requirements of the number of stipulated shareholders with an emphasis on diversification to explicit diversification provisions in the form of minimum percentage divestiture upon listing. Furthermore considerable differences in financial reporting, accounting and auditing performance are also apparent with these varying considerably from very small markets in fledgling transition economies such as Laos and Cambodia to large developed "world" markets such as Tokyo, Hong Kong, Australia and Singapore.

In all these differences represent very real differences in transactions costs between national equity markets across Asia where these in turn are mirrored in liquidity. This underscores our focus on liquidity in the remainder of this paper.

2.2 Liquidity constructs

A key feature of heterogeneous multi country samples such as the Asian region is the considerable institutional differences between markets which is reflected in their size and activity and ultimately liquidity. Consequently a direct result of this heterogeneity from a sample comprising large developed markets such as Tokyo alongside fledgling exchanges such as Laos, Cambodia and Maldives is the inapplicability of high frequency measures of liquidity (Goyenko et al, 2011). Furthermore volume based measures such as turnover are susceptible to misrepresentation where these record high levels of liquidity in financial crises or periods of uncertainty that are in reality accumulated masses of sell orders of investors exiting market. An additional problem limiting the choice of potential liquidity estimators is a lack of trading data in many smaller markets rendering measures such as the Amihud (2002) price-impact metric inestimable. A further pertinent issue is the documented "freezing" of market activity by Easley and O'Hara (2010) where trading activity is effectively "frozen" with no buy nor sell orders. Easley and O'Hara argue this to be the result of severe uncertainty rendering trader unable to rank investment opportunities by expected utility and value. Inability to rank infers an inability to participate in markets due to uncertainty. The multidimensional construct of Liu (2006) is one of the few liquidity estimators capable of handling these issues. Here freezing is represented in terms of a lack of trading volume – captured in the measure.

The Liu (2006) measure is defined as LM_x which is the standardized turnover-adjusted number of zero daily trading volumes over the prior x months (x = 1, 6, 12) i.e.

$$LM_x = \left[(\text{Number of zero daily volumes in prior x months}) + \frac{\text{1/x month turnover}}{\text{Deflator}} \right] * \frac{21x}{\text{NoTD}} \qquad (1)$$

where x month turnover is the turnover over the prior x months, calculated as the sum of the daily turnover over the prior x months, daily turnover is the ratio of the number of shares traded on a day to the number of shares outstanding at the end of the day, NoTD is the total number of trading days in the market over the prior x months, and Deflator is chosen such that,

$$0 < \frac{1/(\text{x month turnover})}{\text{Deflator}} < 1 \qquad (2)$$

for all sample stocks[1]. Given the turnover adjustment (the second term in brackets in first expression), two stocks with the same integer number of zero daily trading volumes can be distinguished: the one with the larger turnover is more liquid. Thus, the turnover adjustment acts as a tie-breaker when sorting stocks based on the number of zero daily trading volumes over the prior x months. Because the number of trading days can vary from 15 to 23, multiplication by the factor (21x/ NoTD) standardizes the number of trading days in a month to 21, which makes the liquidity measure comparable over time. LM1 can be interpreted as the turnover-adjusted number of zero daily trading volumes over the prior 21 trading days, which is the approximate average number of trading days in a month. The liquidity measure, LM_x is calculated at the end of each month for each individual stock based on daily data. Daily data is available for all markets across the sample period.

3 Data

3.1 Sample selection

Our final sample is formed from a series of screening stages firstly at the market-level and then in terms of data availability at an individual stock-level. As such we initially include all stock markets across Asia where data is available. Our definition of Asia is broad and extends beyond the MSCI definition[2] of "developed" – that focuses on Singapore, Hong Kong and Japan and "emerging" – that focuses on China, Indonesia, Malaysia, South Korea, India. As such we also include Australia, New Zealand and the Pacific territories of Fiji and Papua New Guinea. We also include very small markets recently established in Laos and Cambodia and markets established in transition economies of Vietnam, Mongolia alongside "frontier" South Asian markets of Bangladesh, Sri Lanka, Pakistan and Nepal. In addition we include former soviet central Asian markets of Armenia, Azerbaijan and Kazakhstan. However data was completely unavailable from Kyrgyzstan and Uzbekistan despite

[1]Following Liu (2006) a deflator of 11,000 is used in constructing estimates for LM1

[2] MSCI definitions are sourced from MSCI website http://www.msci.com/products/indexes/country_and_regional/dm/

the presence of small national markets in both countries[3]. We also extend our Asian universe to include Indian Ocean territories of Maldives, Seychelles, Mauritius and Oman. Data limitations from Bloomberg alongside wholesale omission from Datastream caused our dropping of Nepal, where only 1 month of data was available, and Azerbaijan owing to incompleteness and omissions.

We then select stock-level data from the major blue-chip index constituent lists available in Datastream (as outlined in Appendix Table 4) while we selectively access data from similar blue-chip index constituents from Bloomberg where data was unavailable in Datastream. In this latter case we obtained lists of stocks constituent to blue-chip indices from national stock exchanges and then selectively downloaded data from Bloomberg. Only in the case of Maldives was data obtained direct from national stock exchange. We use the stocks constituent to blue-chip indices as these conform to international investors "investability" requirements, in terms of marketability and accessibility (foreign ownership restrictions) of these assets while at the same time avoiding the thorny issue of imposed bias from pre-screening stocks based upon pre-determined minimum price criteria. This price pre-screening is evident in the study of Hou et al (2011) focussing on a worldwide sample of 49 countries. The use of blue-chip index constituent stocks also conforms to international asset diversification assumptions regarding inter-market asset market integration, which is essential in the CAPM methodology, and thus avoids issues regarding intra-market segmentation which is particularly prevalent in emerging stock markets. Finally we also include the major market in countries where there are more than one market present. This is the case in Vietnam where the Ho Chi Minh stock exchange is larger and has a more international orientation than its Hanoi-based counterpart as well as in Bangladesh, where Dhaka forms the basis of our analysis and we omit the regional market of Chittagong, and Pakistan, where we focus on Karachi, omitting regional markets such as Islamabad and Lahore. This is also true in India where we focus on Bombay stock exchange – although the blue-chip index we use captures the largest and most

[3] Stock exchange websites in both Russian and English are available in both countries however there is no capacity to download comprehensive market data on an individual stock basis. Kyrgyzstan stock exchange website is: http://www.kse.kg/ while its Uzbek counterpart is at: http://www.uzse.uz/new/main/main.asp. This compounds the lack of data from Bloomberg and Datastream underscoring their omission from further study.

liquid firms from across India. However we do include the developed regional markets in Japan outside Tokyo, namely Osaka, Nagoya, Fukuoka and Sapporo and both Chinese exchanges, Shenzen and Shanghai.

We select a sample time frame from January 2000 to August 2014 with a view that while being relatively short it is reflective of the period within which many emerging and frontier markets were established and adopted conventional data dissemination and financial reporting. We screen our sample to include ordinary shares only – and omit preference shares, warrants, convertibles, REITs, closed-end funds, exchange traded funds and depository receipts. Furthermore we adopt stock screening techniques of Ince and Porter (2003). Firstly any return above 300% that is reversed within one month is treated as "missing" – i.e. if R_t or R_{t-1} is greater than 300%, and $(1 + R_t)*(1 + R_{t-1}) - 1 < 50\%$, then both R_t and R_{t-1} are set to "missing".

Following Hou et al (2011) we ensure accounting ratios are known before returns and thus match the end of year financial statement data for year t-1 with monthly returns from July of year t to June of year t + 1. We use the inverse of the "market-to-book-ratio" (see Appendix Table 2) in Datastream and similarly the inverse of "Market_Capitalization_to_BV" in Bloomberg to calculate the Book to Market Value ratios. In addition size is defined as the market value of equity at the end of June of year t, while momentum (Mom) for month t is the cumulative raw return from month t – 6 to month t – 2, skipping month t – 1 to mitigate the impact of microstructure biases such as bid-ask bounce or non-synchronous trading.

Summary statistics for all Asian markets, including Nepal, Kazakhstan, Armenia and Azerbaijan, Fiji and Papua New Guinea that are omitted from further study, are provided in Table 1. These reveal marked differences in liquidity and trading statistics across Asian markets. Generally bid-ask spreads are lowest for the prominent developed markets of Tokyo, Australia, Hong Kong and Singapore, where these are typically under 2%, and rise dramatically to the smaller, more peripheral frontier markets of Fiji, Armenia, Kazakhstan and Seychelles, where this is typically in excess of 30%. It is notable that Fiji and Seychelles as well as Papua New Guinea and Maldives use continuous auction trading systems in markets that are severely constrained by the very limited

economy – hemmed in by a combination of geographic remoteness and the limited land territory of the islands within which they are situated (see Hearn and Piesse, 2010 for discussion on constraints facing very small exchanges). However more generally the evidence supports some co-movement between the proportion of daily zero returns measure and the multidimensional Liu (2006) 1 year ranking metric. Markets with high daily zero returns (i.e. price rigidity) also have characteristically high illiquidity reflected in multidimensional Liu metric. This provides some support for the assertion in Liu (2006) that the metric goes some way in capturing a lack of minority investor trading due to the costs of informational asymmetry between firm insiders and minority outside investors. A final observation is that the average levels of percentage free float co-move to a degree with daily zero returns and Liu (2006) liquidity measures – namely that higher liquidity appears related to higher aggregate proportions of free float. An explanation for this would likely focus on elevated institutional protection for minority shareholder property rights also facilitating external finance and capital market development thus leading to elevated liquidity owing to increased participation of minority investors in capital markets. We omit from further study the markets of Nepal and Azerbaijan owing to the lack of availability of data while Fiji is omitted owing to a five year gap in trading due to political instability. Armenia, Kazakhstan and Papua New Guinea are omitted owing to their significant segmentation with rest of Asia and erratic time series returns structure – reflected in returns in excess of 1,000%, which is a function of markets severe illiquidity leading to sudden unprecedented price movements.

Table 2

3.2 Factor mimicking portfolio construction

In order to study the influence of factors such as size (market capitalization), book to market value, momentum, and liquidity on the variation of Asian stock returns, we follow Fama and French (1993), Liu (2006) and Hou et al (2011) in constructing returns-based proxy factors based on zero-investment portfolios that go long in stocks with high values of a particular characteristic (such as book to market value, momentum or liquidity) and short in stocks with low values for that

characteristic. Our ultimate goal is to employ the time-series regression approach of Black, Jensen and Scholes (1972) which has been applied first by Fama and French (1993) and then more widely across the literature with recent applications such as Liu (2006) in assessing the practical pricing implications arising from self-constructed liquidity metric. In this approach the excess returns on test portfolios are regressed on the returns of various candidate factor mimicking portfolios (hereafter FMPs). The time series slopes have interpretations of their being factor loadings or factor sensitivities, thereby facilitating our judgement as to how well various combinations of these FMPs can explain the average returns across a wide variety of portfolios.

As we use an array of characteristics – namely the size and book to market value of Fama and French (1993), the momentum of Jagadeesh and Titman (1993) which is also incorporated into models alongside size and book to market value by Carhart (1997), and liquidity of Liu (2006) we form our FMPs using two distinctive techniques. The first relates to the formation of 25 quintile portfolios using a two-stage sorting process first sorting stocks into five portfolios based on their size, each of which is further sorted in a second stage by book to market value of each stock. At each of the two stages any stocks with missing values of size or book to market value are omitted as are stocks with negative book to market values. FMPs relating to size are formed from average returns on small size portfolio minus those on big size portfolio (also termed as SMB or size factor) and separately high book to market value portfolio minus low book to market portfolio (also termed as HML factor). It is important to note that portfolio rebalancing takes place annually in June of each year – in accordance to Fama and French (1993) and Hou et al (2011). SMB and HML factors are formed from value-weighted returns.

In contrast both momentum and liquidity use 10 decile portfolios with stocks ranked and sorted across portfolios based on their momentum, defined as cumulative return over preceding six months, or liquidity, which is defined in preceding section following procedures outlined in Liu (2006). The FMP for momentum is formed following Jagadeesh and Titman (1993) six-month/six-month strategy, whereby each month's return is an equal-weighted average of six individual strategies of buying the winner decile portfolio and selling the losing decile portfolio, with

rebalancing occurring monthly[4]. In order to minimize the bid-ask bounce effect, we skip one month between ranking and holding periods when constructing momentum FMP. Momentum FMP is formed from equal-weighted returns.

In terms of the formation of liquidity FMP and stocks are first ranked according to their respective Liu (2006) liquidity metrics. These are sorted into 10 decile portfolios with the liquidity FMP formed from returns difference between high illiquidity decile portfolio and low illiquidity decile portfolios. At this stage we proceed into the contrasting formation of two respective liquidity FMPs based on the frequency of rebalancing. The first assumes a simple annual rebalancing taking place in December of each year – in line with the Fama and French (1993) procedure. The second assumes a monthly rebalancing with the ultimate FMP returns formed from the averages across each of twelve annually held liquidity FMPs with these having been formed through monthly rebalancing – which is similar to the method employed for the momentum portfolio of Jagadeesh and Titman (1993)[5]. This was also employed as a robustness check in Liu (2006).

Evidence of the stock sorting process across all ten decile portfolios, based on a sort from the Liu liquidity 1 year metric, is provided in Table 3. This is limited on the Asia overall universe for brevity, while similar profiles are available from authors from Asia excluding Japan and Japan only universes. The findings reveal that there is a distinct bias implicit in the stock sorting process at a regional level where stocks from only a handful of constituent markets feature in the low

[4] For example the momentum FMP return for January 2001 is 1/6 of the return spread between the winners and losers from July 2000 through November 2000, 1/6 of the return spread between winners and losers from June 2000 through October 2000, 1/6 the return spread between winners and losers from May 2000 through September 2000, 1/6 of the return spread between winners and losers from April 2000 through August 2000, 1/6 of the return spread between winners and losers from March 2000 through July 2000, and 1/6 of the return spread between the winners and losers from February 2000 through June 2000

[5] Using monthly rebalancing for an annually constructed liquidity measure with annual holding periods the monthly liquidity factor return for January 2005 (for example) is formed from 1/12 of the return spread between high liquidity ranked stocks and low liquidity ranked stocks for January 2003 through January 2004 (with the subsequent decile portfolios held annually), 1/12 of return spread between high and low liquidity stocks for February 2003 through February 2004, 1/12 of return spread between high and low liquidity stocks for March 2003 through March 2004, 1/12 of return spread between high and low stocks for April 2003 and April 2004, 1/12 of return spread between high and low liquidity stocks for May 2003 through May 2004, 1/12 of return spread between high and low liquidity stocks for June 2003 through June 2004, 1/12 of return spread between high and low liquidity stocks for July 2003 through July 2004, 1/12 return spread between high and low liquidity stocks for August 2003 through August 2004, 1/12 the return spread between high and low liquidity stocks for September 2003 through September 2004, 1/12 return spread between high and low liquidity stocks for October 2003 through October 2004, 1/12 return spread between high and low liquidity ranked stocks for November 2003 through November 2004, and 1/12 return spread between high and low liquidity ranked stocks for December 2003 through December 2004.

illiquidity D1 decile, notably Australia, New Zealand and Singapore, while a similarly geographically skewed profile exists for the high illiquidity portfolio, D10. In this latter portfolio the smaller regional Japanese markets, such as Osaka, Fukuoka and Nagoya feature prominently alongside Pakistan, Mauritius and a wide dispersion of illiquid stocks drawn from across the region.

This geographic skewness to profiles of the extreme profiles (upon which the valuation factors are based) is also evident across 1 month rebalanced liquidity portfolios, momentum and the Fama and French (1993) size and book-to-market portfolios as evident in Table 4. This evidence alone points to likely problems with regards segmentation inherent to the formation of valuation factors based on portfolio sorting process across a widely dispersed geographic regional universe.

Tables 3 and 4

Decisions regarding the suitability and optimality of CAPM-based models augmented with certain valuation factors and not others proceeds from the evidence presented in Table 5. Here descriptive statistics regarding each of the valuation factors reveals that while their average returns over the sample period are generally low, there is considerable variation in the standard deviations of these returns. Furthermore most factors are statistically different from zero – albeit at a low $p \leq 0.10$ level of significance. Jarque-bera non-normality tests, as with skewness and kurtosis test statistics reveal that several of the factors returns series deviate substantially from ideal statistical Normal distributions. However deviations of this size are anticipated in such a broad, diverse sample encompassing all of Asia.

More generally correlations are low between all factors while they are highly statistically significant. This mitigates concerns over multicollinearity from their joint inclusion into multifactor models while also providing some insight into the uniqueness of each factor in not being closely related to other factors nor to common underlying trends in data series. Furthermore autocorrelations are minimal too. Finally the evidence regarding the intrinsic differences between the highest and lowest illiquidity-sorted decile portfolios (D1 and D10) is provided in panel 4. This

in turn reveals substantial differences between the constituent stocks within each portfolio which provides some support for their employment in the liquidity valuation factor formation.

Table 5

4. Models

4.1 Time invariant parameter augmented CAPM framework

The standard capital asset pricing model (CAPM) of Sharpe (1964) and Lintner (1965) states that excess returns on a stock or portfolio of stocks are positively related to those of the market. Formally this is stated in expected returns:

$$\mathrm{E}(\mathrm{r}_{\mathrm{pt}}) - \mathrm{r}_{\mathrm{ft}} = \beta_{\mathrm{M}} \left[\mathrm{E}(\mathrm{r}_{\mathrm{mt}}) - \mathrm{r}_{\mathrm{ft}}\right] \tag{3}$$

where r_{pt} is the returns on a portfolio p of stocks at time interval t, r_{mt} is the returns on market portfolio and r_{ft} the risk free rate. This can be rearranged and estimated by OLS regression:

$$\mathrm{r}_{\mathrm{pt}} - \mathrm{r}_{\mathrm{ft}} = \alpha_{\mathrm{i}} + \beta_{\mathrm{M}} (\mathrm{r}_{\mathrm{mt}} - \mathrm{r}_{\mathrm{ft}}) + \varepsilon_{\mathrm{it}} \tag{4}$$

where α_{i} is the constant, or Jensen alpha, β_{M} is market coefficient and $\varepsilon_{\mathrm{it}}$ is an independently identically distributed (iid) disturbance term.

Following Fama and French (1993) the one factor CAPM can be further augmented with expected returns attributable to size and book-to-market effects:

$$\mathrm{E}(\mathrm{r}_{\mathrm{pt}}) - \mathrm{r}_{\mathrm{ft}} = \beta_{\mathrm{M}} \left[\mathrm{E}(\mathrm{r}_{\mathrm{mt}}) - \mathrm{r}_{\mathrm{ft}}\right] + \beta_{\mathrm{SMB}} \mathrm{E}(\mathrm{SMB}) + \beta_{\mathrm{HML}} \mathrm{E}(\mathrm{HML}) \tag{5}$$

where the additional SMB and HML terms are the size and book-to-market factors. This can be rearranged and estimated by OLS regression:

$$\mathrm{r}_{\mathrm{pt}} - \mathrm{r}_{\mathrm{ft}} = \alpha_{\mathrm{i}} + \beta_{\mathrm{M}} (\mathrm{r}_{\mathrm{mt}} - \mathrm{r}_{\mathrm{ft}}) + \beta_{\mathrm{SMB}} \mathrm{SMB}_{\mathrm{t}} + \beta_{\mathrm{HML}} \mathrm{HML}_{\mathrm{t}} + \varepsilon_{\mathrm{it}} \tag{6}$$

Following Carhart (1997) and Hou et al (2011) we augment this three-factor Fama and French model with momentum (Mom):

$$\mathrm{E}(\mathrm{r}_{\mathrm{pt}}) - \mathrm{r}_{\mathrm{ft}} = \beta_{\mathrm{M}} \left[\mathrm{E}(\mathrm{r}_{\mathrm{mt}}) - \mathrm{r}_{\mathrm{ft}}\right] + \beta_{\mathrm{SMB}} \mathrm{E}(\mathrm{SMB}) + \beta_{\mathrm{HML}} \mathrm{E}(\mathrm{HML}) + \beta_{\mathrm{Mom}} \mathrm{E}(\mathrm{Mom}) \tag{7}$$

where the additional Mom term is momentum factor. This can be rearranged and estimated by OLS regression:

$$r_{pt} - r_{ft} = \alpha_i + \beta_M (r_{mt} - r_{ft}) + \beta_{SMB} SMB_t + \beta_{HML} HML_t + \beta_{Mom} Mom_t + \varepsilon_{it} \quad (8)$$

Liu (2006) introduces a two-factor liquidity model with the single factor CAPM being augmented by an additional liquidity (illiquidity) factor (ILLIQ):

$$E(r_{pt}) - r_{ft} = \beta_p [E(r_{mt}) - r_{ft}] + \beta_{Illiq} E(ILLIQ) \quad (9)$$

which in turn can be operationalized through OLS methodology into:

$$r_{it} - r_{ft} = \alpha_i + \beta_i (r_{mt} - r_{ft}) + \beta_{Illiq} ILLIQ_t + \varepsilon_{it} \quad (10)$$

Finally we include all factors, namely size, book-to-market value, momentum and liquidity on top of the market factor which in terms of expected returns can be expressed as:

$$\begin{aligned} E(r_{pt}) - r_{ft} = {} & \beta_M [E(r_{mt}) - r_{ft}] + \beta_{SMB} E(SMB) + \beta_{HML} E(HML) \\ & + \beta_{Mom} E(Mom) + \beta_{Illiq} E(ILLIQ) \end{aligned} \quad (11)$$

which in turn can be operationalized through OLS methodology into:

$$\begin{aligned} r_{pt} - r_{ft} = {} & \alpha_i + \beta_M (r_{mt} - r_{ft}) + \beta_{SMB} SMB_t + \beta_{HML} HML_t \\ & + \beta_{Mom} Mom_t + \beta_{Illiq} ILLIQ_t + \varepsilon_{it} \end{aligned} \quad (12)$$

where the variables are described above and ε_{it} is an independently identically distributed (iid) disturbance term. The model is estimated using time series Ordinary Least Squares (OLS) techniques, following Black, Jensen and Scholes (1972), in line with Fama and French (1993); Pastor and Stambaugh (2003); and Liu (2006). The expectation is that the Jensen alpha should not be statistically different from zero given the theoretical relationship between an individual portfolios expected returns and those of the market (Markowitz 1959). However, Scholes and Williams (1977) found that using standard OLS resulted in beta estimates that are biased downwards for securities infrequently trading and upwards for those traded more often. Dimson (1979) also found the beta estimate is inefficient in thinly traded stocks and proposes a correction technique based on the aggregation of betas from lagged and leading regression coefficients. Dimson and Marsh (1983) propose a second correction technique, which uses a trade-to-trade

method measuring and matching returns between individual stocks or portfolios and the market index between the times of the last trades in successive months. The use of standard OLS here follows the work of Pastor and Stambaugh (2003), Liu (2006) and Martinez (2005) who use these techniques extensively in their studies involving multifactor CAPM models capturing liquidity effects. However the limitations of standard OLS must be taken into account particularly when applied to the smaller and significantly less liquid markets such as Philippines and Indonesia.

In addition to our standard time-series study of parameter coefficients attributed to various factors for a single market universe – namely the aggregate Asian universe, we also assess the performance of all the time series models in explaining returns of first the 25 size and book to market value quintile portfolios and then the 10 decile liquidity portfolios, formed through the stock sorting process across three consecutive universes: aggregate Asia, Asia excluding Japan and then Japan only (including all the regional Japanese markets and Tokyo). We judge each model by the Gibbons, Ross and Shanken (1989) (hereafter referred to as GRS) F-test for the hypothesis that the intercepts are jointly equal to zero across the test assets of interest. It is notable that this methodology is that unconditional and ignores potential time variation in the premiums. Further limitation is that it ignores that slope coefficients may vary over time. While Harvey (1991), Chan et al (1992), Ferson and Harvey (1993, 1994) amongst others have proposed time varying conditional asset pricing tests we develop our study through the application of the Kalman filter time varying parameter methodology to asset pricing models in the next section to address this limitation.

4.2 Time varying parameter augmented CAPM framework

Following Brooks et al (1998) the time varying parameter equivalent of the linear CAPM uses the Kalman filter and relies on the notion of state space to estimate the conditional constant term and market beta of the multifactor CAPM. This is represented by an observation equation and a transition or state equation, that in combination express the structure and dynamics of a time varying system. A state space model is specified where an observation at time t is a linear

combination of a set state variables, which compose the state vector at time t. Assuming the number of state variables is m and the (m x 1) vector is θ_t then the observation equation can be represented by:

$$y_t = z_t\theta_t + \mu_t, \qquad \mu_t \sim N(0,\sigma_\mu^2) \tag{13}$$

where z_t is assumed to be known (m x 1) vector, and μ_t is the observation error, which is assumed to be normally distributed with zero mean. The set of state variables is defined from the minimum set of information from past and present data and future values of time series are completely determined by the present values of the state variables (the Markov property). The state space model incorporates unobserved variables and estimates them with the observable model, in imposing a time varying structure of the CAPM beta. The conditional betas are estimated using the following observation equation:

$$\begin{aligned} R_{it} &= \alpha_t + \beta_{it}^{Kalman} R_{Mt} + s_i^{Kalman} SMB + h_i^{Kalman} HML + m_i^{Kalman} Mom + z_i^{Kalman} ILLIQ + \varepsilon_t, \\ \varepsilon_t &\sim N(0,\Omega) \end{aligned} \tag{14}$$

where R_{it} and R_{Mt} are the excess returns on the individual portfolio and market portfolios at time t and ε_t is disturbance term. The exact form of the transition equation depends on the form of stochastic process the betas are assumed to follow and in this case a simple random walk is imposed as outlined in Brooks et al (2000). The transition equation is defined:

$$\alpha_{it}^{Kalman} = \alpha_{it-1}^{Kalman} + \eta_{\alpha t,} \qquad \eta_{\alpha t} \sim N(0,Q) \tag{15}$$

$$\beta_{it}^{Kalman} = \beta_{it-1}^{Kalman} + \eta_{\beta t,} \qquad \eta_{\beta t} \sim N(0,Q) \tag{16}$$

$$s_{it}^{Kalman} = s_{it-1}^{Kalman} + \eta_{st,} \qquad \eta_{st} \sim N(0,Q) \tag{17}$$

$$h_{it}^{Kalman} = h_{it-1}^{Kalman} + \eta_{ht,} \qquad \eta_{ht} \sim N(0,Q) \tag{18}$$

$$m_{it}^{Kalman} = m_{it-1}^{Kalman} + \eta_{ht,} \qquad \eta_{ht} \sim N(0,Q) \tag{19}$$

$$z_{it}^{Kalman} = z_{it-1}^{Kalman} + \eta_{ht,} \qquad \eta_{ht} \sim N(0,Q) \tag{20}$$

Together equations 14 and the combination of 15 to 20 constitute a Kalman filter state space model. However, a set of prior conditional values are necessary to forecast the future value expressed as:

$$\alpha_0^{Kalman} \sim N(\alpha_0^{Kalman}, P_0) \quad (21)$$

$$\beta_0^{Kalman} \sim N(\beta_0^{Kalman}, P_0) \quad (22)$$

$$s_0^{Kalman} \sim N(s_0^{Kalman}, P_0) \quad (23)$$

$$h_0^{Kalman} \sim N(h_0^{Kalman}, P_0) \quad (24)$$

$$m_0^{Kalman} \sim N(m_0^{Kalman}, P_0) \quad (25)$$

$$z_0^{Kalman} \sim N(z_0^{Kalman}, P_0) \quad (26)$$

Brooks et al (1998) cite that this technique uses the first two observations to establish the prior conditions and then recursively estimates the entire series providing conditional estimates of $z_{it}^{Kalman}, m_{it}^{Kalman}, \beta_{it}^{Kalman}, s_{it}^{Kalman}, h_{it}^{Kalman}$ and α_{it}^{Kalman}.

5. Empirical results

5.1 Time-invariant empirical results – single aggregate Asian market universe

Evidence from the factor coefficients, associated t-statistics and adjusted R^2 for a range of augmented CAPM-based models is provided in Table 6 and 7. The former (Table 6) focuses on 25 size book-to-market quintile portfolios as the test assets, while the latter (Table 7) focuses on liquidity sorted decile (10) portfolios. The universe is Asia overall, although similar results are fund across Asia excluding Japan and Japan only universes.

The findings from Table 6 reveal that across the universe of 25 size, book-to-market sorted constituent portfolios, the Fama and French (1993) three factor model (henceforth FF3F) yields the best results in terms of explaining the cross section of stock returns. The FF3F has a higher R^2 than comparable single factor CAPM models while also importantly having a reduced statistical

significance associated with Jensen alpha's across all 25 models. It is notable that a four factor (4F) augmented model, including the momentum factor, yields no discernable improvement over the FF3F model, while the coefficients associated with momentum factor almost wholly lack statistical significance at any confidence margin. A final observation is that while both two factor liquidity augmented models (first with 1 year rebalanced measure and second with 1 month rebalanced measure) lack the explanatory power of preceding models, such as FF3F or 4F, that the coefficients associated with the 1 month rebalanced measure almost wholly lack statistical significance across all 25 quintile portfolios. This would infer that of the two liquidity-based models the 1 year rebalanced model yields superior explanatory power in contrast to its 1 month rebalanced counterpart. However to sum up – and the evidence from 25 quintile sorted portfolios alludes to the superiority of FF3F model.

The evidence from Table 7 reveal that the single factor CAPM is poor in terms of the majority of decile time series regressions having statistically significant Jensen alpha terms and yielding markedly lower R^2 than any other class of model. FF3F models yield a considerable reduction in statistical significance of Jensen alpha term and increase in R^2 across all decile portfolios. This is also true of 4F (FF3F plus momentum factor) models although notably the beta coefficients associated with momentum factor almost wholly lack statistical significance with the sole exception of highest (D10) illiquidity portfolio. There is equally a marked contrast in the performance between the two two-factor liquidity models i.e. the 1 year rebalancing factor and 1 month rebalancing factor. The former yields elevated R^2 and reduced significance of Jensen alpha terms while the latter (1 month rebalancing) generally yields lower R^2 explanatory power and has a greater number of constituent regressions with statistically significant Jensen alpha terms. The R^2 explanatory power of the two-factor (1 year rebalancing) liquidity model is on a par with that of the five factor (5F) overall model containing all factors together (with the sole exception of 1 month rebalancing liquidity factor which is omitted in place of its 1 year counterpart). To sum up and the evidence from time series regressions in Table 7 infers the superiority of the two-factor (1 year rebalancing) liquidity model over all other alternative multifactor models.

Tables 6 and 7

5.2 Time-invariant empirical results – comparison across universes

We use the F statistic from the Gibbons, Ross and Shanken (1989) (henceforth GRS) to formally test the hypothesis that a set of explanatory variables produces regression intercepts for a set of test assets or portfolios that are all jointly equal to zero. We use six sets of explanatory variables in all – with each corresponding to one augmented CAPM-based model. These are employed on a set of test assets, or portfolios, which are the individual decile portfolios sorted on basis of 1-month rebalanced liquidity, 1-year rebalanced liquidity and then momentum. A further final set of test portfolios is derived from country-level portfolios, albeit for those countries with time series of the same length as that of overall sample. Thus smaller country-level time series were dropped from consideration, such as country portfolios for Oman, Laos, Cambodia where at best only a few years data were available. It should be noted that a complication arises due to collinearity between the formation of GRS test statistic and the valuation factors implicitly used within the models it is employed. As such we run GRS tests across 8 of the decile portfolios in each case – omitting the extreme portfolios (D1 and D10) from which liquidity and momentum valuation factors are formed. Furthermore owing to the complex formation of both the FF3F size and book-to-market valuation factors – which are based on portfolio formation from across the sample universe, we omit the 25 quintile size and book-to-market sorted portfolios from consideration under GRS methods.

The results from Table 8 overwhelmingly reject null hypotheses of all regression intercepts being jointly equal to zero. These are rejected with $p \leq 0.01$ confidence margin. Furthermore we repeated these GRS tests across all three universes, namely Japan only (in panel 1), Asia excluding Japan (in panel 2), and then Asia overall (in panel 3). The rejection is universal across these universes too. This high and universal level of rejection by GRS method is also a common finding in literature with Fama and French (1993) reporting similar evidence in a single country US-based sample and Hou et al (2011) in a multi-country sample focussing on large world markets. While this unanimous rejection of null hypothesis of joint intercepts equalling zero underscores an

inability to use the GRS effectively to discriminate between comparable models, it does reveal the weakness of time invariant methods as a class of model in being robust to intra and inter-market segmentation. This is a particular problem in multi-country samples, such as our Asia overall universe and Asia excluding Japan universe, but it is also prevalent within the Japan only universe. This is comprised of 5 regional equity markets peripheral to the central "world" market of Tokyo where these are socially embedded within Japan's distinctive regional political economies – such as Sapporo market in distant Hokkaido island, alongside similarly distinctive Fukuoka and Nagoya exchanges in equally distant and distinctive regional political economies. In this light the GRS test statistics provide strong support for the weakness of time invariant parameter asset pricing models.

Table 8

5.3 Time varying parameter empirical evidence

The results arising from our application of the Kalman filter methods to relax the time-invariant assumptions inherent within the neoclassical asset pricing methodology associated with CAPM-type multifactor models are presented in Table 9. Further to having estimated all time varying models the mean time series time-varying alpha (time-varying equivalent to intercept) alongside the proportion of sample for which it's associated lower standard error band is negative are reported. Coefficients with lower standard error bands that are negative are deemed to lack statistical significance. The importance of this lacking in statistical significance (or negative standard errors) in the context of each models alpha is that this "fits" with theory inasmuch that asset pricing theory predicts alpha (Jensen alpha) should not be statistically significantly different from zero. As a final means of discriminating between models we use the Aikaike Informational Criterion (AIC) statistic.

The results reveal substantial support for the use of time varying CAPM-based models. An overwhelming majority of lower standard error bands of alphas are negative (generally over 90% of sample period). Furthermore the average z-statistics of final period alphas are generally extremely low and below any discernable confidence margin.

Finally the evidence from AIC statistics reveal a general tendency for tests undertaken on quintile portfolios to favour FF3F model (i.e. CAPM augmented with size and book-to-market terms) while tests undertaken on the three classes of momentum, liquidity (1 year rebalance) and liquidity (1 month rebalance) portfolios reveals a general preference for the two-factor CAPM augmented by the 1-year liquidity factor. These preferences based on AIC are similar across Log Likelihood, SBC and HAC information criterion too – though these have been omitted for brevity.

Table 9

5.4 Time-varying parameter models and structural breaks

We further elaborate on time-varying parameter coefficient models through their application to two factor CAPM models augmented with 1 year liquidity factor with these being applied to the modelling of individual country-level portfolios. The loci of each of the three parameters arising from these models, namely alpha, beta on market portfolio, and beta on liquidity factor, are revealed in Figures 1 to 26.

Figures 1 to 16 reveal significant structural breaks in time-varying loci of market beta coefficients as well as liquidity beta coefficients for Vietnam, China (Shanghai), New Zealand, Hong Kong and Malaysia. In particular these reveal the utility of time-varying methods over and above conventional time-invariant models where in all cases the loci of alpha terms is centred on 0, despite obvious variation around this and while the lower standard error band is generally negative inferring a lack of statistical significance. In particular the appreciation of the market beta in Vietnam and China (Shanghai) in the latter part of sample period infers the greater degree of integration of these markets with that of the wider Asian region. Hong Kong by comparison has a relatively stable, if variable, market beta loci centred on value 1 underscoring the centrality of this market within the Asian market universe.

Figures 1 - 15

Figures 16 to 21 reveal the time-varying coefficient loci, for alpha market beta and liquidity beta respectively, for two very small equity markets within the Asian region: Mauritius and Maldives. The market beta coefficient loci for Mauritius in particular exhibits similar profile of distinct structural breaks that is common to larger markets outlined above, such as Hong Kong, New Zealand and Shanghai (China). However the time-varying liquidity beta loci in particular bears a strong resemblance to that estimated in Hearn (2012) although in that study a shorter sample period was used (ending in 2008) and the estimation universe was that of Sub Saharan Africa. In contrast the extremely small micro-market of Maldives has a market beta centring on zero – inferring minimal integration with Asian regional universe. However the liquidity beta locus exhibits two distinct phases of significant elevation. Each corresponds to a period of distinct domestic political uncertainty. However the more general complete lack of integration of Maldives market with Asian universe is very apparent in terms of both market and liquidity betas centring on zero for much of the sample period.

Figures 16 - 21

Finally figures 22 to 26 reveal that time varying coefficient loci for models estimated on Tokyo (Japan) using two respective market universes: the first being Asia overall and the second being Japan only. While both profiles of time varying alphas are centred on zero, the alpha generated on Asia overall universe exhibits much greater variation than its counterpart estimated on Japan only universe. Similar differences are apparent in the market beta loci – where that estimated on Asia overall universe exhibits more variation in contrast to its Japan only universe counterpart where the market beta is clearly centred on value 1, indicating the dominance and centrality of Tokyo within Japanese universe.

Figures 22 - 26

6. Conclusions

This paper contrasts six capital asset pricing models (CAPM) augmented with different sets of five valuation factors – including Fama and French (1993) size and accounting book-to-market value, Jagadeesh and Titman (1993) momentum, and the liquidity factor of Liu (2006) constructed firstly using an annual rebalancing period and secondly using a monthly rebalancing period. The sample used is based on a comprehensive Asian universe comprise of top tier blue chip stocks from 29 constituent markets. Two sub-samples derived from this are also used: the first based on all Asian countries excluding Japan and the second being Japan only. This latter national universe contains Tokyo plus four regional Japanese markets. As a final means of gauging the impact of segmentation within market universes on modelling techniques we undertake a comparison of the time-invariant parameter models, upon which conventional CAPM methodology is based, we develop Kalman filter time-varying parameter models using same factors as their time-invariant counterparts.

Our findings suggest there is considerable inter and intra-market segmentation which is apparent both within the single national universe of Japan as well as the broader and more heterogeneous Asia excluding Japan and Asia overall universes. This segmentation is reflected in the poor performance of time-invariant parameter models upon which the conventional CAPM and augmented CAPM methodology is based. In contrast time-varying models employing the Kalman filter yield valid alternatives with differentiation of optimal performing models being based on maximum likelihood information criterion. We find evidence that the two factor liquidity augmented CAPM outperforms alternative augmented CAPM specifications in explaining the cross section of stock returns. Furthermore while the benefits of the additional liquidity factor are centred on the annual rebalancing metric as opposed to its monthly rebalanced counterpart.

Overall our findings are important for investment managers seeking to hedge risks when diversifying across multi-country regional universes, such as Asia, and firm's financial managers seeking to raise capital and thereby attaining a better understanding of the impact of various risks in terms of cost of equity capital.

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Table 1. Summary of institutional characteristics

This appendix table provides descriptive data on the institutional environments, regulatory pillars and regulatory and listing requirements across all Asian sample group markets.
Time zone difference with Singapore in parentheses (+ / - hours)

Country	Institutional environment	Regulatory Authorities	Min no shareholders	Balance sheet performance criteria
Australasia				
Australia (+3 hours)	Formal: English common law Informal: Individualistic	(1) The Australian Securities and Investments Commission; (2) The Reserve Bank of Australia; (3) Federal government department of treasury; (4) The Australian Prudential Regulatory Authority; (5) Council of Financial Regulators	- Min. 400 with individual holdings of min. A$2000 - Min. 350 with individual holdings of min. A$2000 with 25% held by unrelated parties - Min. 300 with individual holdings of min. A$2000 with 50% held by unrelated parties	- A$1m net profit over last 3 years + A$400,000 over last 12 years - A$3m in net tangible assets/ or A$10m in market capitalization
New Zealand (+5 hours)	Formal: English common law Informal: Individualistic	(1) NZX Regulation; (2) NZX Markets Disciplinary Tribunal; (3) Financial Markets Authority; (4) Commerce Commission; (5) Takeovers Panel	- Min. 500 shareholders with 25% of total issued equity	- Min. Mkt Cap: NZ$50m
Papua New Guinea (+2 hours)	Formal: English common law Informal: Polynesian Communitarian	(1) Investment Promotion Authority; (2) The Securities Commission	- Min 20% issued and outstanding shares must be owned by at least 50 members of public.	- Profits in last 3 years of min. K600,000 - Min asset base of K1.5m
Fiji	Formal: English common law Informal: Polynesian/ Indian Communitarian	(1) Reserve Bank of Fiji; (2) Capital Markets Development Authority	- Min. amount issued: F$1m	- Min operating history of 3 years - Working capital reserves for a min. 12 months - Min. 5 year s financial statements
Asia-Pacific				
Taiwan (+1 hours)	Formal: German civil code Informal: Chinese Confucian	(1) Ministry of Finance; (2) Financial Supervisory Commission	- At least 1,000 shareholders, and where insiders of the foreign issuer and juristic persons own over 50% of the shareholding, no less than 500 shareholders other than such insiders own at least 20% of the total issued shares (or not less than 10 million shares)	- Cumulative pre-tax earnings of at least NT$250 million over the last 3 fiscal years, with at least NT$120 million in the latest fiscal year, and no cumulative losses. - Paid-in capital or shareholders' equity of at least NT$600 million or market capitalization over NT$1,600 million
South Korea (+2 hours)	Formal: German civil code Informal: Mixed communitarian	(1) Market Oversight Commission; (2) Financial Services Commission; (3) Financial Supervisory Services	- Capital size: Either (1) KRW 10b (USD 10m) or (2) KRW 20b (USD 20m) - Min. free float: 25%	- Min. 3 years operating history - Sales: Recent year KRW 30b & 3years avg. KRW 20b - Income: Recent year KRW 2.5b & 3years KRW 5b - ROE: Recent year 5% & 3 years 10%
Philippines (+1 hours)	Formal: Spanish civil code Informal: Mixed communitarian	(1) Central Bank; (2) Securities and Exchange Commission; (3) Bureau of Treasury	- Min. authorized capital stock of P500M, of which, at least 25% is subscribed and fully paid. - Min. Market Cap: P500M - Min 1,000 stockholders each owning stocks	- Cumulative consolidated earnings before interest, taxes, depreciation and amortization (EBITDA), excluding non-recurring items, of at least P50 Million for three (3) full fiscal years immediately

			equivalent to at least one (1) board lot	preceding the application for listing - Min. EBITDA of P10 Million for each of the 3fiscal years - Min operating history last 3 years prior to listing
Hong Kong (+1 hours)	Formal: English common law Informal: Chinese Confucian	(1) Securities and Futures Commission; (2) Financial Secretary; (3) Hong Kong Monetary Authority	- Min. Market Cap. HK$200 million - Min. Free Float: 25%	- Min. HK$50 million in the last 3 financial years (with profits of at least HK$20 million recorded in the most recent year, and aggregate profits of at least HK$30 million recorded in the 2 years before that) - Min. HK$500m for the most recent audited financial year - Positive cashflow from operating activities of > HK$100m for the 3 preceding financial years
Indonesia (0)	Formal: Netherlands civil code (related to French civil code) Informal: Islamic	(1) Ministry of Finance; (2) BAPEPAM Indonesian Capital Market Supervisory Agency	- Min Net Tangible Assets: IDR 10b - Min no shareholders: 100 - Min Shares owned by the minority shareholders: 100 million shares or 35% of the paid-up capital	- Min operating history: 3 years - Audit opinion of Financial Report: Standard Unqualified Opinion, for the last 2 financial years plus the latest interim Audited Financial Statement
China: Shanghai (+1 hours)	Formal: German civil code Informal: Chinese Confucian	(1) State Council (PRC government); (2) Capital Market Supervisory Agency	- Min. total share capital: RMB 50m with 25% float - For issuer with total share capital of over RMB 400m then public float is reduced to 10%	- 3 years financial reports and no illegal acts
China: Shenzen (+1 hours)	Formal: German civil code Informal: Chinese Confucian	As Shanghai	- Min total share capital RMB 30 million - The intangible assets as at the end of the last reporting period (after deducting land use rights, aquaculture rights, mining rights, etc.) shall not account for more than 20% of the net assets	- 3 consecutive years net profits of min. RMB 30m - Min Net cash flow in the last 3 years > RMB 50m - Min revenue in the last 3 financial years > RMB 300m
Malaysia (+1 hours)	Formal: English common law Informal: Islamic	(1) Securities Commission; (2) Ministry of Finance	- 25% public float with minimum number of 1,000 public shareholders each holding not less than 100 shares	- Min. 5 years audited financial statements with an aggregate Profit After Tax of at least RM20 million and a Profit After Tax of at least RM6 million for the most recent financial year - Min. Market Cap. RM500 million - Min operating history: 3 years
Singapore (0)	Formal: English common law Informal: Mixed communitarian	(1) Monetary Authority of Singapore; (2) Securities Industry Council	- Min 500 shareholders - Market cap. < S$300m: 25% free float - Market cap. S$300m - S$400m: 20% free	- Profit test: Cumulative pre-tax profits of at least S$7.5 million over the last 3 consecutive years, with a pre-tax profit of

			float - Market cap. S$400m - S$1b: 15% free float - Market cap.> S$1b: 12% free float	at least S$1 million in each of those 3 years - Cumulative pre-tax profits of at least S$10 million for the latest 1 or 2 years - Min 3 years consistent operating track record
Thailand (0)	Formal: English common law Informal: Buddhist	(1) Bank of Thailand; (2) Office of the Securities and Exchange Commission	- Min No minority shareholders: 1,000	- Min. operating history: 3 years - must have had the same company management for at least one year prior to the application date - Profits test: must have the following net profit characteristics: combined minimum net profits from operations of THB 50 million over the past two or three years. net profits from operations of THB 30 million for the latest full year. - net profits from operations in the year of filing the listing application, when all quarterly results from that year are combined - Market capitalization test: Market Cap > THB 5b
Vietnam (Ho Chi Minh) (0)	Formal: French civil code Informal: Socialist/ Communitarian	(1) Central Bank; (2) State Securities Commission (SSC) – Hanoi stock exchange is regulated by same authorities	- Min. shareholders: At least 20% of the voting shares of the applicant company must be held by at least 100 shareholders	- Capitalisation: Firm must have a minimum book value of VND 80 billion (USD 5 million) in paid-up charter capital. - Profitability: Firm must have been profitable for the last two consecutive years and there must not be any accumulated losses up to the year of listing
Cambodia (0)	Formal: French civil code Informal: Socialist/ Communitarian	(1) Ministry of Finance; (Central bank; (3) Securities And Exchange Commission Of Cambodia	- No. shares held by shareholders < 1% voting shares: voting shares of shareholders holding less than 1% voting shares shall be more than 200,000 or 15% of the total voting shares, whichever is larger	- Net profit for the last 3 years - Audited financial statements for the last 3 years;
Laos (0)	Formal: French civil code Informal: Socialist/ Communitarian	(1) Bank of the Lao PDR; (2) Securities and Exchange Commission	Shareholding criteria: - Min no. shares 100,000 shares - Min Market Capitalization: 10b KIP - Min no minority shareholders: 100 - Min free float: 10%	- Min 3 years historical operating history with accompanying financial statements - Min sales revenues: 30b KIP - In the recent 3 years, there shall be net income in the latest 2 consecutive years - No impairment of capital stock in the recent year
Mongolia	Formal: German civil code	(1) Financial Regulatory Commission	- Min capitalization 10m Turgug (MNT)	- Min operating history: 3 years

(+1 hours)	Informal: Socialist/ Communitarian		- Min 30% free float	- Min. Non-current assets of 20% of total value of securities - Security issuer must be in profit, if the issuer in loss the amount of loss shall be equal no more than 30 % of the total equity of company
Japan: Tokyo (+2 hours)	Formal: German civil code Informal: Communitarian	(1) Japan Financial Services Agency; (2) Bank of Japan; (3) Securities and Exchange Surveillance Commission	- Min No shareholders: 2,200 - Min No tradable shares: 20,000 - Min Market capitalization: 25b Yen - Min free float: 35%	- Min 3 years operating history - Min. net assets: ¥1b - Min profits in the last 2 years: ¥500m - Min market capitalization: ¥50b - Min sales for the last year: ¥10b
Japan: Sapporo (+2 hours)	Formal: German civil code Informal: Communitarian	As Tokyo	Min. no of shareholders: 2,000 Min public free float: 80%	- Min operating history: 1 year - Min asset value: ¥300m - Min Ordinary Profit: Y50m
Japan: Osaka (+2 hours)	Formal: German civil code Informal: Communitarian	As Tokyo	As Tokyo	As Tokyo
Japan: Fukuoka (+2 hours)	Formal: German civil code Informal: Communitarian	As Tokyo	- 2,000 or more stocks required at time of listing - Min Free Float: 20% at time of listing - Min No Japanese shareholders: 300	- Min. Market capitalization: ¥ 1b - Min operating history: At least 3 years - Min total assets: ¥ 300m - Min operating profit for last 1 year: ¥ 50m
Japan: Nagoya (+2 hours)	Formal: German civil code Informal: Communitarian	As Tokyo		
South Asia				
India (Bombay SE) (-2 hours)	Formal: English common law Informal: Hindu and mixed communitarian	(1) Ministry of Finance (Department of Economic Affairs - Capital Markets Division); (2) Securities and Exchange Board of India; (3) Reserve Bank of India		- Min post-issue paid-up capital of firm Rs. 10 crore - Min issue size shall be Rs. 10 crore - Min market capitalization: Rs. 25 crore
Pakistan (Karachi SE) (-2 hours)	Formal: English common law Informal: Islamic	(1) Securities and Exchange Commission of Pakistan; (2) Central Bank; (3) Ministry of Finance	2 classifications of listing: (1) If firm's issued capital is less than Rs 500m the min. free float is 25% (2) If firm's issued capital greater than Rs 500m the min free float is 12.5% with this being gradually increased to 25% over ensuing 4 years of listing	- Min paid-up capital is Rs.200m
Bangladesh (Dhaka SE) (-1 hours)	Formal: English common law Informal: Islamic	(1) Board of Investment; (2) Bangladesh Securities and Exchange Commission; (3) Central bank		- Min paid up capital of Taka 100m - No accumulated loss - Min operating history of 5 years - 3 years profit out of the immediate last five completed accounting/financial years with steady growth pattern

Nepal (-2 hours)	Formal: English common law Informal: Hindu and mixed communitarian	(1) Securities Board of Nepal; (2) Central Bank		
Sri Lanka (-2 hours)	Formal: English common law Informal: Buddhist and mixed communitarian	(1) Securities Exchange Commission; (2) Central Bank; (3) Ministry of Finance	- Min free float of 25% and min 1,000 public shareholders holding not less 100 shares each	- Min stated capital (Rs.500,000,000/-) - Net profit after tax for 3 consecutive years immediately preceding the date of application - Positive Net Assets as per the consolidated audited financial statements for the last 2 financial years immediately preceding the date of application
Central Asia				
Armenia (-3 hours)	Formal: French civil code Informal: Former Socialist and Christian	(1) Central Bank of Armenia	- Min free float of 15% - In order to have its securities included in main list, the Issuer should ensure that the security has at least one Market marker on the Exchange	- Min value of securities 500m Armenian drams - Min operating history of 3 years - Min 3 years audited financial statements
Kazakhstan (-1 hours)	Formal: French civil code Informal: Former Socialist and communitarian/ Islamic	(1) National Bank of the Republic of Kazakhstan; (2) Committee for Control and Supervision of the Financial Market and Financial Organizations	- Min 100,000 shares for registration on exchange - Min free float is 20%	- Min 3 years operating history
Indian Ocean				
Oman (-3 hours)	Formal: English common law Informal: Islamic	(1) Central Bank of Oman; (2) Capital Market Authority		
Maldives (-2 hours)	Formal: English common law Informal: Islamic	(1) Ministry of Finance and Treasury; (2) Monetary Authority of Maldives; (3) Capital Market Development Authority	- Issued and paid up capital of MVR 5M - Min 10% of issued capital involved in offer (IPO) and min 250,000 shares with value of MVR 500,000	- 3 years financial statements and operating history - Profit for min of 2 previous years - No litigation/illegal acts during last 2 years
Seychelles (-3 hours)	Formal: English common law Informal: Islamic and mixed communitarian	(1) Financial Services Supervision Division (FSSD) of the Central Bank of Seychelles; (2) Financial Services Authority of Seychelles	- Min free float of 25% dispersed to min 60 individual shareholders - Min capital raised: US$35	- Min operating history of 3 years - Min 3 years profitability - Firm must appoint a min. of 3 executive directors in full time employment
Mauritius (-3 hours)	Formal: French civil code Informal: Mixed African and Asian communitarian	(1) Bank of Mauritius; (2) Financial Services Commission	- Min free float: 25%	- Min market capitalization MUR20million (approximately USD700K) - Min operating history of 3 years

Source: Compiled by authors from national stock exchange websites
Notes: Definition of legal family (origin) is from La Porta et al (2008)

Table 2. Descriptive statistics

This table provides descriptive statistics for all the equity markets across Asia including those of Australasia and South Pacific as well as Indian Ocean and Caucasus (broadly defined as central Asia) regions. The sample start for each market is outlined while the common end date across all markets is August 2014. N refers to total number of listed firms per market. Three liquidity measures are summarized: LOT (1999) proportion of daily zero returns per month, the bid-ask spread (defined in Lesmond, 2005) and the liquidity metric of Liu (2006) estimated (ranked) over a preceding 1 year period. The bid-ask spread construct of Lesmond (2005) is defined as:

$$\text{Quoted spread}_M = 1/2\left[\left(\frac{(\text{Ask}_M - \text{Bid}_M)}{(\text{Ask}_M + \text{Bid}_M)/2}\right) + \left(\frac{(\text{Ask}_{M-1} - \text{Bid}_{M-1})}{(\text{Ask}_{M-1} + \text{Bid}_{M-1})/2}\right)\right]$$

where subscript M is month representing the Ask and Bid prices in that period. Correspondingly the LOT (1999) proportion of daily zero returns in a month is detailed as:

$$\frac{1}{D_M}\sum_{D=1}^{n}(\text{Zero Daily Return})$$

where D_M is the number of days in the month, M. Finally the Liu (2006) metric is defined as LM_x which is the standardized turnover-adjusted number of zero daily trading volumes over the prior x months (x = 1, 6, 12) i.e.

$$LM_x = \left[(\text{Number of zero daily volumes in prior x months}) + \frac{1/\text{x month turnover}}{\text{Deflator}}\right] * \frac{21x}{\text{NoTD}}$$

where x month turnover is the turnover over the prior x months, calculated as the sum of the daily turnover over the prior x months, daily turnover is the ratio of the number of shares traded on a day to the number of shares outstanding at the end of the day, NoTD is the total number of trading days in the market over the prior x months, and Deflator is chosen such that,

$$0 < \frac{1/(\text{x month turnover})}{\text{Deflator}} < 1$$

Traded volume is average monthly traded volume across stocks included within each market. Finally in US$ converted terms average stock prices are reported alongside average market capitalization (firm size measure) for stocks included in each market. The average proportion of free float in percentage terms is detailed. We also document whether market is included in final modelling sample – in the formation of market universes, where the basis of inclusion is centred on the amount of historical data available which being least for Nepal (1 month only) and equally severely limited for Azerbaijan underscore the omission of these two markets from inclusion in market universes and later study.

Country	Sample time period start	Inclusion in sample?	N	Local market				US$		
				Daily zero returns	Bid-Ask spread	Liu (2006) metric (1 year)	Traded Volume	Price, US$	Market Cap	Free Float
				%	%		Shares, b	US$	US$,b	%
Japan										
Japan: Tokyo	Jan/2000	Yes	150	9.93 [9.09]	0.35 [0.29]	15.66 [14.53]	124.03 [57.41]	25.30 [14.79]	12.92 [8.01]	84.60 [90.25]
Japan: Sapporo	Jan/2000	Yes	59	27.10 [14.28]	2.88 [0.61]	48.42 [14.53]	47.29 [2.51]	9.09 [5.06]	6.90 [0.28]	76.56 [86.52]
Japan: Osaka	Jan/2000	Yes	204	39.50 [35.00]	3.08 [2.01]	62.70 [39.10]	1.88 [0.11]	36.09 [2.98]	0.42 [0.04]	65.74 [68.97]
Japan: Fukuoka	Jan/2000	Yes	36	60.41 [68.18]	4.37 [2.73]	118.47 [138.98]	1.75 [0.027]	6.09 [4.41]	0.26 [0.06]	67.07 [71.00]
Japan: Nagoya	Jan/2000	Yes	82	55.84 [56.52]	5.16 [2.95]	105.19 [99.44]	0.11 [0.04]	7.45 [4.34]	0.12 [0.05]	66.41 [72.00]
Australasia										
Australia	Jan/2000	Yes	200	16.26 [10.00]	2.19 [0.97]	19.84 [7.72]	51.34 [18.56]	6.55 [3.30]	4.61 [1.29]	71.18 [76.92]
New Zealand	Jan/2000	Yes	50	32.33 [27.27]	4.96 [0.97]	26.63 [9.65]	16.18 [4.70]	2.66 [1.44]	2.69 [0.43]	68.91 [75.00]
Papua New Guinea	Nov/2011	No	7	92.18 [100.00]	2.70 [1.83]	180.47 [220.65]	0.33 [0.06]	5.24 [0.73]	0.53 [0.09]	-- --
Fiji	Jan/2000	No	16	98.49 [100.00]	37.46 [29.40]	236.81 [241.42]	0.06 [0.01]	1.06 [1.08]	0.011 [0.01]	34.34 [23.10]
Asia-Pacific										
Taiwan	Jan/2000	Yes	100	14.16 [9.52]	0.41 [0.29]	15.80 [12.60]	267.02 [142.56]	1.66 [0.83]	3.26 [1.20]	75.16 [78.00]
South Korea	Jan/2000	Yes	100	10.53 [9.09]	0.32 [0.27]	16.70 [12.55]	17.06 [7.91]	95.47 [43.59]	5.71 [2.82]	63.04 [64.00]
Philippines	Jan/2000	Yes	30	35.45 [33.33]	3.35 [1.50]	42.22 [16.41]	106.19 [26.34]	3.19 [0.22]	2.69 [0.76]	39.38 [34.00]
Hong Kong	Jan/2000	Yes	200	24.33 [18.18]	5.80 [0.94]	33.25 [14.53]	115.99 [37.41]	10.61 [0.50]	69.76 [0.62]	49.01 [47.00]

Indonesia	Jan/2000	Yes	45	32.32 [26.08]	3.07 [0.96]	36.05 [17.44]	560.85 [181.15]	0.36 [0.13]	3.75 [0.70]	38.57 [35.00]
China: Shanghai	Jan/2000	Yes	180	16.51 [9.09]	0.16 [0.14]	34.09 [21.24]	411.04 [199.46]	1.21 [0.72]	5.36 [0.55]	47.87 [46.00]
China: Shenzen	Jan/2000	Yes	100	16.79 [9.09]	0.15 [0.11]	33.12 [21.64]	322.53 [184.82]	1.35 [0.85]	1.63 [0.71]	51.78 [50.00]
Malaysia	Jan/2011	Yes	100	39.07 [30.43]	4.49 [0.95]	23.29 [14.53]	36.35 [9.73]	1.26 [0.69]	1.48 [0.32]	52.84 [48.05]
Singapore	Jan/2000	Yes	183	35.51 [30.00]	7.79 [1.26]	39.20 [11.58]	73.31 [14.82]	1.20 [0.46]	1.52 [0.23]	49.95 [45.00]
Thailand	Jan/2000	Yes	100	26.80 [22.72]	0.99 [0.76]	23.86 [15.44]	329.65 [88.21]	0.80 [0.26]	1.44 [0.34]	56.26 [58.00]
Vietnam	June/2002	Yes	100	28.52 [23.81]	1.15 [0.88]	50.73 [12.60]	7.06 [2.08]	1.28 [0.92]	0.18 [0.05]	63.88 [49.59]
Cambodia	Apr/2012	Yes	2	58.95 [59.09]	-- --	52.55 [0.01]	0.42 [0.32]	1.52 [1.55]	0.13 [0.13]	-- --
Laos	Jan/2011	Yes	3	48.95 [51.13]	1.52 [1.42]	55.41 [28.48]	1.07 [0.73]	0.87 [0.89]	0.44 [0.39]	-- --
Mongolia	July/2007	Yes	18	66.14 [71.42]	9.45 [6.38]	118.63 [110.56]	0.30 [0.06]	6.27 [2.36]	0.03 [0.01]	-- --
South Asia										
India	Dec/2000	Yes	100	6.64 [4.54]	0.54 [0.37]	16.29 [11.58]	61.86 [28.82]	6.86 [4.20]	4.28 [1.66]	57.18 [72.00]
Pakistan	Jan/2000	Yes	100	25.79 [10.95]	12.25 [0.67]	52.07 [15.99]	63.05 [3.58]	1.46 [0.49]	0.27 [0.08]	43.43 [43.00]
Bangladesh	Jan/2000	Yes	27	22.92 [14.28]	-- --	45.75 [25.00]	15.37 [5.14]	1.03 [0.30]	0.12 [0.002]	-- --
Nepal	Aug/2014	No	10	47.97 [45.45]	-- --	-- --	0.06 [0.005]	-- --	-- --	-- --
Sri Lanka	Jan/2000	Yes	20	39.32 [33.71]	8.64 [2.55]	51.60 [34.75]	4.72 [0.99]	1.00 [0.42]	0.17 [0.04]	88.95 [92.50]
Central Asia										
Armenia	Jan/2002	No	12	99.40 [100.00]	31.93 [20.20]	246.89 [248.64]	0.009 [0.001]	56.04 [2.86]	0.01 [0.01]	-- --
Azerbaijan	Aug/2013	No	187	99.89 [100.00]	-- --	245.23 [243.79]	-- --	3.29 [2.55]	0.33 [0.33]	-- --
Kazakhstan	Jan/2002	No	78	88.21 [100.00]	41.42 [25.92]	225.62 [243.38]	2.22 [0.03]	103.65 [9.98]	0.76 [0.09]	24.09 [21.01]
Indian Ocean										
Oman	Nov/2005	Yes	29	66.25 [69.56]	1.36 [0.91]	50.61 [25.10]	12.72 [6.59]	1.32 [0.75]	0.47 [0.21]	58.32 [65.00]
Maldives	Apr/2002	Yes	6	90.83 [93.18]	-- --	220.21 [225.45]	3.87 [0.09]	32.68 [20.83]	0.11 [0.04]	33.68 [33.73]
Seychelles	Aug/2013	Yes	3	89.12 [95.45]	32.40 [3.31]	243.33 [240.38]	0.02 [0.01]	5.33 [5.51]	0.01 [0.01]	21.21 [25.00]
Mauritius	Jan/2000	Yes	40	71.64 [72.72]	3.48 [2.69]	96.79 [78.87]	8.35 [0.11]	1.66 [1.29]	0.09 [0.003]	45.61 [40.00]
Universes										
Japan	Jan/2000		531	32.79 [23.81]	2.71 [1.39]	58.27 [19.38]	40.93 [0.23]	22.77 [4.88]	4.53 [0.10]	71.68 [78.00]
Asia Ex-Japan	Jan/2000		2,137	31.83 [18.18]	4.50 [0.69]	44.11 [15.45]	137.88 [19.21]	13.04 [1.14]	7.60 [0.58]	76.69 [52.00]
Asia Overall	Jan/2000		2,669	32.03 [18.18]	4.10 [0.74]	47.21 [15.51]	117.92 [12.18]	30.22 [1.68]	6.93 [0.48]	92.90 [58.40]

Source: Compiled by authors from Bloomberg and Datastream

Table 3. Stock distribution amongst factor portfolios – for Aggregate Asian regional market universe

Table documenting the distribution of stocks (in terms of nationality or origin market) across decile liquidity-sorted portfolios which constitute a core part of the formation of the returns-based liquidity valuation factor based on the aggregate Asian market universe (including Japanese regional markets).

	Decile liquidity - 1 year sorted portfolio distribution									
	D1 (Low Illiquidity)	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10 (High Illiquidity)**
Japan										
Japan: Tokyo	0.00	17.78	24.66	38.29	54.20	6.95	0.95	0.29	0.29	0.59
Japan: Sapporo	0.00	2.78	6.15	8.41	14.95	5.61	1.05	0.95	4.00	9.83
Japan: Osaka	0.00	1.38	4.76	10.21	16.80	20.45	20.18	36.24	52.17	35.15
Japan: Fukuoka	0.00	0.29	0.80	0.85	1.71	1.17	0.51	1.51	6.88	17.73
Japan: Nagoya	0.00	0.00	0.51	1.07	2.56	3.15	4.00	8.34	22.95	33.29
Australasia										
Australia	117.34	11.32	3.17	1.83	1.17	1.90	2.54	4.46	5.49	6.63
New Zealand	16.02	11.41	1.22	0.80	0.37	0.66	1.39	1.24	0.95	3.22
Asia-Pacific										
Taiwan	0.00	24.15	28.02	19.90	5.55	11.49	0.93	1.17	0.51	0.80
South Korea	6.59	26.37	31.23	8.93	10.14	0.80	0.66	1.39	0.68	1.32
Philippines	0.07	2.93	0.80	3.95	1.61	5.12	5.95	1.83	1.51	2.63
Hong Kong	3.10	5.95	25.77	32.02	24.99	18.01	18.54	14.57	13.45	9.74
Indonesia	0.00	0.29	2.13	3.34	1.17	10.45	7.13	2.06	1.23	1.48
China: Shanghai	0.00	0.00	0.00	1.83	2.63	28.24	51.22	37.02	11.12	7.29
China: Shenzen	0.00	0.00	0.00	0.73	1.10	13.83	26.95	19.83	7.02	3.98
Malaysia	0.00	2.63	10.24	17.98	21.05	12.97	10.93	10.02	4.37	1.73
Singapore	42.71	32.17	5.88	3.68	3.20	3.59	7.20	12.90	19.93	14.27
Thailand	0.00	0.00	10.90	11.12	15.29	25.05	9.71	2.63	1.83	2.61
Vietnam	0.15	14.49	7.73	2.98	3.12	1.66	1.39	1.88	3.17	5.85
Cambodia	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00
Laos	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.20	0.15	0.00
Mongolia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.63
South Asia										
India	13.83	29.80	15.98	10.39	5.93	6.66	1.83	0.95	1.02	1.24
Pakistan	2.27	8.05	11.12	11.10	3.12	9.66	6.32	8.12	13.07	11.68
Bangladesh	0.00	0.00	0.00	0.73	0.07	2.34	3.80	8.56	2.15	1.95
Sri Lanka	0.00	0.00	0.00	0.00	0.00	0.95	4.71	8.20	4.17	1.60
Indian Ocean										
Oman	0.00	0.22	0.73	1.27	0.98	0.80	2.95	2.83	3.68	3.05
Maldives	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.22
Seychelles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
Mauritius	0.00	0.12	0.15	0.59	0.29	0.29	1.12	4.61	9.95	9.22

Table 4. Stock distribution amongst factor portfolios – for Aggregate Asian regional market universe

Table documenting the distribution of stocks (in terms of nationality or origin market) across quintile and decile factor-sorted portfolios based on the aggregate Asian market universe (including Japanese regional markets).

	Fama and French (1993)				**Liquidity**				**Momentum**	
	SMB		**Book to Market Value**		**1y Rebalance**		**1m Rebalance**		**6m/6m**	
	Small	**Big**	**Low**	**High**	**D1 (Low)**	**D10 (High)**	**D1 (Low)**	**D10 (High)**	**D1 (Low)**	**D10 (High)**
Japan										
Japan: Tokyo	1.76	115.29	14.78	34.39	0.00	0.59	0.00	0.56	9.69	6.01
Japan: Sapporo	12.60	12.76	2.45	22.80	0.00	9.83	0.00	10.25	3.76	3.09
Japan: Osaka	103.48	0.75	14.73	59.56	0.00	35.15	0.00	36.59	21.34	14.97
Japan: Fukuoka	13.60	0.64	2.15	9.07	0.00	17.73	0.00	18.20	3.30	2.05
Japan: Nagoya	33.85	0.64	4.19	23.14	0.00	33.29	0.00	34.32	6.24	4.17
Australasia										
Australia	8.32	41.11	40.73	18.82	117.34	6.63	114.53	5.82	12.84	15.28
New Zealand	2.33	0.92	8.33	2.73	16.02	3.22	14.85	2.89	1.61	2.48
Asia-Pacific										
Taiwan	1.13	21.34	12.81	11.93	0.00	0.80	2.95	0.82	7.82	7.25
South Korea	0.85	33.61	7.95	32.04	6.59	1.32	11.18	1.28	7.35	10.66
Philippines	1.62	3.58	3.41	5.04	0.07	2.63	0.15	2.76	2.17	2.98
Hong Kong	15.74	38.66	26.16	58.58	3.10	9.74	2.90	9.88	24.26	18.46
Indonesia	3.86	5.15	10.32	1.43	0.00	1.48	0.04	1.22	3.61	4.82
China: Shanghai	8.12	22.82	63.99	1.82	0.00	7.29	0.00	6.84	19.28	17.30
China: Shenzen	3.24	6.71	35.28	1.21	0.00	3.98	0.00	4.02	9.64	11.05
Malaysia	7.07	9.71	8.69	21.40	0.00	1.73	0.00	1.93	6.84	3.85
Singapore	20.65	14.31	22.38	23.82	42.71	14.27	33.39	14.99	13.15	11.37
Thailand	15.24	7.88	19.19	8.25	0.00	2.61	0.00	2.09	9.25	11.61
Vietnam	21.09	0.00	15.69	1.33	0.15	5.85	2.42	5.12	9.38	5.49
Cambodia	0.01	0.00	0.00	0.00	0.05	0.00	0.07	0.05	0.02	0.00
Laos	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.05	0.00
Mongolia	0.00	0.00	0.00	0.00	0.00	0.63	0.00	0.45	1.49	1.73
South Asia										
India	6.35	25.11	33.12	8.86	13.83	1.24	18.71	1.39	9.02	11.39
Pakistan	26.46	1.21	18.82	6.74	2.27	11.68	1.95	11.25	10.07	12.94
Bangladesh	0.00	0.00	0.00	0.00	0.00	1.95	0.00	1.74	2.47	4.02
Sri Lanka	6.57	0.00	4.35	0.42	0.00	1.60	0.00	1.66	1.92	3.06
Indian Ocean										
Oman	5.52	0.14	3.05	0.28	0.00	3.05	0.25	2.60	2.11	1.98
Maldives	0.00	0.00	0.00	0.00	0.00	3.22	0.00	3.44	0.77	0.35
Seychelles	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.05	0.00	0.00
Mauritius	13.13	0.00	3.85	2.80	0.00	9.22	0.00	9.55	1.50	1.85

Table 5. Factor mimicking portfolio summary statistics – for Aggregate Asian regional market universe

This table provides the descriptive statistics, autocorrelations (at 1, 6 and 12 lags respectively) for returns-based valuation factors including Market, the Fama and French (1993) size (SMB) and book to market value (HML), Jagadeesh and Titman (1993) momentum factor and Liu (2006) liquidity factor – all of which are used to explain cross section of stock returns across market universe. The market universe in this case is that of aggregate Asia. Summary statistics are also reported, alongside t-difference in means, for the highest and lowest liquidity sorted portfolios (from which the liquidity-based valuation factor is formed). These are based on stock returns, book-to-market value, size (market capitalization), stock price, traded volume, monthly bid-ask spread and monthly percentage daily volatility in daily stock returns. Liquidity portfolios D1 and D10 are formed from annual rebalancing.

Panel 1: Descriptive statistics	**Market**	**SMB**	**HML**	**Liquidity (1 year)**	**Liquidity (1 Month)**	**Momentum**
Mean (%)	0.25%	2.73%	0.47%	-0.48%	-0.54%	0.74%
t-statistic	-1.34*	6.84††	1.28*	-0.44	-1.31*	1.89**
Standard Deviation (%)	9.95%	5.29%	4.76%	13.63%	6.23%	5.59%
Skewness	-1.91	-0.21	0.10	4.04	0.29	-1.46
Kurtosis	30.30	8.53	6.23	43.24	4.24	8.66
Jarque-Bera statistic	5,193.15 (0)	210.48 (0)	71.71 (0)	11,511.14 (0)	12.86 (0)	276.92 (0)
Number of months	164	164	164	164	164	164

Panel 2: Pearson correlations	**Market**	**SMB**	**HML**	**Liquidity (1 year)**	**Liquidity (1 Month)**	**Momentum**
Market	1.0000					
SMB	-0.5808††	1.0000				
HML (Book to Mkt value)	0.3542††	-0.1473**	1.0000			
Liquidity (1 Year Rebal)	0.5722††	-0.4710††	0.3306††	1.0000		
Liquidity (1 Month Rebal)	-0.2267††	0.1303**	-0.2045††	0.3825††	1.0000	
Momentum	-0.0677	0.1609**	0.0442	0.0735	0.2161††	1.0000

Panel 3: Autocorrelations	**Market**	**SMB**	**HML**	**Liquidity (1 year)**	**Liquidity (1 Month)**	**Momentum**
1-Lag	0.102	-0.113	-0.090	-0.286	-0.023	0.282
6-Lags	0.014	-0.012	0.023	-0.123	-0.189	-0.019
12-Lags	-0.113	-0.124	-0.009	-0.006	0.027	0.007

Panel 4: Summary statistics	**Liquidity portfolio D1**	**Liquidity portfolio D10**	**T - statistic**
	Value-weighted	**Value-weighted**	
	Mean	**Mean**	
Returns	0.85%	1.39%	-0.77
Book to Market value	0.4013	0.5006	-2.54†
Size (Market Cap, US$m)	37,432.11	27,614.54	1.79**
Price	8.43	23.53	-7.98††
Traded Vol. (shares, m)	657.18	145.69	5.38††
Free Float, %	41.01%	76.42%	-26.76††
Momentum	11.35%	8.53%	1.12
Bid-Ask spread, month %	3.41%	0.55%	9.11††
Volatility, daily month, %	2.07%	1.67%	4.89††
Daily Zero Ret., month %	32.36%	9.42%	15.12††
Liu 1 month	12.98	0.95	2.75††
Liu 1 year	99.94	8.39	23.93††

*p<0.10; **p<0.05; †p<0.01; ††p<0.005

Table 6. Empirical results for 25 Size and Book-to-Market value sorts quintile portfolios – for Aggregate Asian regional market universe

This table provides the beta coefficients against valuation factors alongside their respective t-statistics, explanatory power (R-squared) and standard errors for the Fama and French (1993) three factor model (including size and book to market value), Carhart (1997) four factor model (including size, book to market value and momentum terms) and two factor liquidity model of Liu (2006) in modelling returns of 25 size and book to market value sorted quintile portfolios (formed from two-pass stock sorting technique of Fama and French (1993)). Note that 5 denotes smallest size or Book to Market value while 1 denotes the largest – so SMB-5/HML-5 denotes the smallest size, smallest book-to-market value sorted portfolio while the opposite is true of SMB-1/HML-1 where this is the largest size, largest book-to-market value sorted portfolio

Panel 1: CAPM

Alpha	**HML-sorted**					**t-statistics**	**HML-sorted**				
SMB-sorted	**High**	**2**	**3**	**4**	**Low**	**SMB-sorted**	**High**	**2**	**3**	**4**	**Low**
Big	0.0462	0.0353	0.0338	0.0403	0.0511	**Big**	5.97	4.62	4.50	5.69	6.20
2	0.0264	0.0251	0.0310	0.0289	0.0275	**2**	4.64	4.21	4.21	4.24	4.12
3	0.0196	0.0181	0.0235	0.0243	0.0260	**3**	3.23	3.54	4.10	4.19	4.29
4	0.0153	0.0158	0.0201	0.0171	0.0274	**4**	3.39	3.31	3.63	3.49	4.47
Small	0.0058	0.0040	0.0034	0.0069	0.0153	**Small**	1.20	0.72	0.61	1.29	2.70

Market Beta						**t-statistics**					
	High	**2**	**3**	**4**	**Low**		**High**	**2**	**3**	**4**	**Low**
Big	0.2476	0.1959	0.1822	0.2400	0.2376	**Big**	2.33	1.95	2.29	2.56	1.99
2	0.1958	0.2553	0.2140	0.2142	0.2587	**2**	1.85	2.59	1.97	2.16	2.23
3	0.2270	0.2068	0.2282	0.2587	0.2633	**3**	1.84	2.08	2.28	2.52	2.16
4	0.2072	0.2364	0.2419	0.2603	0.2640	**4**	2.31	2.31	2.62	2.74	2.09
Small	0.2194	0.5307	0.2831	0.9959	0.2125	**Small**	2.27	2.48	2.44	4.19	1.75

R-squared						**Standard Error**					
	High	**2**	**3**	**4**	**Low**		**High**	**2**	**3**	**4**	**Low**
Big	0.0917	0.0909	0.0886	0.1454	0.0709	**Big**	0.0917	0.0729	0.0687	0.0692	0.1003
2	0.1054	0.1845	0.1199	0.1288	0.1591	**2**	0.0674	0.0641	0.0687	0.0661	0.0709
3	0.1378	0.1619	0.1734	0.2084	0.1747	**3**	0.0675	0.0561	0.0595	0.0604	0.0683
4	0.1880	0.2050	0.1909	0.2281	0.1490	**4**	0.0515	0.0557	0.0595	0.0574	0.0751
Small	0.1826	0.3594	0.1812	0.6819	0.1029	**Small**	0.0554	0.0853	0.0719	0.0822	0.0741

Panel 2: Three-factor Fama French (1993) model

Alpha						**t-statistics**					
	High	**2**	**3**	**4**	**Low**		**High**	**2**	**3**	**4**	**Low**
Big	0.0088	0.0009	-0.0012	0.0117	0.0044	**Big**	1.49	0.15	-0.22	2.10	0.88
2	0.0106	0.0049	0.0068	0.0046	0.0017	**2**	1.60	0.75	1.07	0.78	0.29
3	0.0059	0.0029	0.0046	0.0065	0.0060	**3**	0.90	0.50	0.75	1.03	1.08
4	0.0054	0.0032	0.0028	0.0042	0.0107	**4**	0.94	0.56	0.44	0.79	1.44
Small	-0.0005	0.0029	-0.0007	0.0156	0.0074	**Small**	-0.08	0.32	-0.13	1.60	1.04

Market Beta

	High	2	3	4	Low
Big	0.5240	0.4160	0.3969	0.4062	0.4703
2	0.3400	0.3831	0.3549	0.3473	0.3880
3	0.3430	0.3265	0.3522	0.3613	0.3474
4	0.2852	0.3166	0.3358	0.3204	0.3270
Small	0.2542	0.5287	0.2860	0.9307	0.2138

t-statistics

	High	2	3	4	Low
Big	6.30	4.56	5.14	4.33	5.23
2	3.25	4.94	3.77	3.88	4.17
3	2.73	3.70	3.65	4.00	3.46
4	3.25	3.43	4.02	3.82	3.42
Small	2.42	2.72	2.89	4.40	1.72

SMB Beta

	High	2	3	4	Low
Big	1.1678	0.9814	0.9741	0.7706	1.1529
2	0.5686	0.5729	0.6539	0.6324	0.6385
3	0.4684	0.4940	0.5481	0.4783	0.4527
4	0.3235	0.3576	0.4490	0.3077	0.3580
Small	0.1655	0.0079	0.0543	-0.2726	0.0918

t-statistics

	High	2	3	4	Low
Big	5.91	6.06	9.69	6.95	7.65
2	4.48	3.99	6.05	6.22	5.41
3	3.82	4.95	5.03	3.79	4.20
4	3.44	3.64	4.10	3.17	2.03
Small	1.36	0.04	0.29	-1.34	0.70

HML Beta

	High	2	3	4	Low
Big	-0.3758	0.1222	0.2584	0.3326	1.0729
2	-0.5298	0.0970	0.2871	0.3929	0.5802
3	-0.3361	-0.2577	0.0308	0.2293	0.6820
4	-0.1554	0.0471	0.3001	0.3601	0.6642
Small	0.1047	0.1387	0.3439	0.1148	0.7083

t-statistics

	High	2	3	4	Low
Big	-2.31	0.72	3.10	3.24	7.09
2	-4.62	0.82	2.63	3.64	5.68
3	-3.36	-3.05	0.30	2.07	8.24
4	-2.21	0.54	3.18	3.67	5.06
Small	1.04	0.92	3.28	0.63	3.54

R-squared

	High	2	3	4	Low
Big	0.3882	0.4703	0.5552	0.4499	0.6337
2	0.2758	0.3332	0.3480	0.3984	0.4611
3	0.2283	0.2939	0.3233	0.3529	0.4450
4	0.2474	0.2733	0.3500	0.3476	0.3351
Small	0.1986	0.3548	0.2086	0.6855	0.2512

Standard Error

	High	2	3	4	Low
Big	0.0753	0.0557	0.0480	0.0556	0.0630
2	0.0606	0.0580	0.0592	0.0550	0.0568
3	0.0639	0.0515	0.0539	0.0546	0.0561
4	0.0496	0.0533	0.0534	0.0528	0.0664
Small	0.0550	0.0857	0.0707	0.0818	0.0677

Panel 3: Four-factor Carhart (1997) model

Alpha

	HML-sorted				
SMB-sorted	**High**	**2**	**3**	**4**	**Low**
Big	0.0100	0.0015	-0.0006	0.0115	0.0052
2	0.0097	0.0056	0.0069	0.0050	0.0020
3	0.0073	0.0030	0.0051	0.0068	0.0063

t-statistics

	HML-sorted				
SMB-sorted	**High**	**2**	**3**	**4**	**Low**
Big	1.62	0.24	-0.11	2.01	1.02
2	1.40	0.85	1.08	0.82	0.31
3	1.04	0.48	0.80	1.05	1.09

4	0.0062	0.0036	0.0029	0.0046	0.0115
Small	0.0001	0.0024	0.0001	0.0166	0.0084

Market Beta

	High	**2**	**3**	**4**	**Low**
Big	0.5185	0.4134	0.3942	0.4073	0.4667
2	0.3438	0.3798	0.3543	0.3456	0.3870
3	0.3368	0.3264	0.3499	0.3599	0.3457
4	0.2816	0.3150	0.3352	0.3186	0.3234
Small	0.2515	0.5307	0.2825	0.9261	0.2094

SMB Beta

	High	**2**	**3**	**4**	**Low**
Big	1.1725	0.9836	0.9763	0.7697	1.1559
2	0.5654	0.5757	0.6544	0.6338	0.6393
3	0.4738	0.4941	0.5500	0.4795	0.4541
4	0.3266	0.3590	0.4496	0.3092	0.3612
Small	0.1678	0.0062	0.0572	-0.2687	0.0955

HML Beta

	High	**2**	**3**	**4**	**Low**
Big	-0.3938	0.1136	0.2497	0.3362	1.0613
2	-0.5174	0.0861	0.2851	0.3874	0.5769
3	-0.3567	-0.2581	0.0233	0.2246	0.6766
4	-0.1672	0.0417	0.2980	0.3542	0.6520
Small	0.0959	0.1452	0.3325	0.0997	0.6939

MOM Beta

	High	**2**	**3**	**4**	**Low**
Big	-0.1480	-0.0707	-0.0710	0.0294	-0.0950
2	0.1014	-0.0895	-0.0167	-0.0447	-0.0267
3	-0.1683	-0.0028	-0.0615	-0.0385	-0.0449
4	-0.0975	-0.0445	-0.0177	-0.0482	-0.1001
Small	-0.0727	0.0532	-0.0939	-0.1236	-0.1183

R-squared

	High	**2**	**3**	**4**	**Low**
Big	0.3918	0.4697	0.5555	0.4470	0.6341
2	0.2777	0.3340	0.3442	0.3960	0.4582
3	0.2401	0.2897	0.3220	0.3499	0.4427

4	1.04	0.60	0.44	0.83	1.49
Small	0.02	0.27	0.01	1.71	1.13

t-statistics

	High	**2**	**3**	**4**	**Low**
Big	6.45	4.52	5.19	4.30	5.19
2	3.27	4.95	3.77	3.90	4.16
3	2.77	3.69	3.64	4.00	3.48
4	3.24	3.44	3.98	3.82	3.44
Small	2.39	2.72	2.91	4.38	1.70

t-statistics

	High	**2**	**3**	**4**	**Low**
Big	6.04	6.14	9.91	6.96	7.58
2	4.53	4.09	6.07	6.30	5.46
3	4.01	4.96	5.11	3.82	4.25
4	3.53	3.67	4.13	3.23	2.06
Small	1.40	0.03	0.30	-1.33	0.74

t-statistics

	High	**2**	**3**	**4**	**Low**
Big	-2.44	0.67	2.88	3.33	7.18
2	-4.58	0.72	2.51	3.54	5.53
3	-3.26	-2.89	0.22	2.01	7.68
4	-2.36	0.47	3.15	3.53	4.86
Small	0.97	0.95	3.14	0.53	3.47

t-statistics

	High	**2**	**3**	**4**	**Low**
Big	-1.00	-0.81	-0.65	0.31	-1.04
2	0.88	-0.88	-0.13	-0.32	-0.23
3	-0.81	-0.03	-0.47	-0.29	-0.32
4	-1.08	-0.40	-0.14	-0.45	-0.69
Small	-0.77	0.63	-0.73	-2.18	-0.93

Standard Error

	High	**2**	**3**	**4**	**Low**
Big	0.0751	0.0557	0.0480	0.0557	0.0630
2	0.0606	0.0580	0.0593	0.0551	0.0570
3	0.0634	0.0517	0.0539	0.0547	0.0562

4	0.2518	0.2705	0.3463	0.3453	0.3358	**4**	0.0494	0.0534	0.0536	0.0529	0.0664
Small	0.1981	0.3517	0.2081	0.6859	0.2537	**Small**	0.0550	0.0859	0.0708	0.0818	0.0676

Panel 4: Two-factor Liu (2006) model (1 Year Rebalance)

Alpha						**t-statistics**					
	High	**2**	**3**	**4**	**Low**		**High**	**2**	**3**	**4**	**Low**
Big	0.0445	0.0346	0.0318	0.0380	0.0502	**Big**	5.98	4.90	4.64	6.05	6.77
2	0.0250	0.0227	0.0288	0.0264	0.0253	**2**	4.46	4.20	4.25	4.31	4.21
3	0.0178	0.0167	0.0218	0.0228	0.0238	**3**	3.20	3.53	4.19	4.30	4.63
4	0.0140	0.0138	0.0182	0.0157	0.0243	**4**	3.48	3.28	3.64	3.56	4.57
Small	0.0065	0.0038	0.0017	0.0048	0.0120	**Small**	1.80	0.63	0.31	0.97	2.41

Market Beta						**t-statistics**					
	High	**2**	**3**	**4**	**Low**		**High**	**2**	**3**	**4**	**Low**
Big	0.4940	0.3987	0.4278	0.5218	0.5399	**Big**	6.03	6.07	5.13	6.20	6.43
2	0.3356	0.5006	0.4881	0.4966	0.5619	**2**	3.50	6.68	5.69	5.48	7.45
3	0.4225	0.3784	0.4613	0.5033	0.5799	**3**	3.39	5.08	5.13	5.47	6.36
4	0.3853	0.4813	0.4852	0.4960	0.6267	**4**	4.44	5.46	5.29	5.81	7.68
Small	0.4324	0.7218	0.5838	0.8541	0.5538	**Small**	5.29	4.06	5.31	5.77	6.76

HML Beta						**t-statistics**					
	High	**2**	**3**	**4**	**Low**		**High**	**2**	**3**	**4**	**Low**
Big	-0.3093	-0.2616	-0.3012	-0.3364	-0.3837	**Big**	-3.35	-4.38	-5.83	-6.94	-5.76
2	-0.1699	-0.3070	-0.3383	-0.3530	-0.3817	**2**	-2.37	-5.90	-6.00	-6.54	-9.31
3	-0.2424	-0.2127	-0.2916	-0.3072	-0.3933	**3**	-3.29	-3.87	-6.85	-5.59	-7.78
4	-0.2207	-0.3024	-0.2952	-0.2926	-0.4438	**4**	-5.60	-6.49	-6.04	-6.02	-6.74
Small	-0.2782	-0.2827	-0.3630	0.2777	-0.4173	**Small**	-7.31	-1.92	-6.11	1.79	-6.95

R-squared						**Standard Error**					
	High	**2**	**3**	**4**	**Low**		**High**	**2**	**3**	**4**	**Low**
Big	0.1859	0.1951	0.2636	0.3585	0.2006	**Big**	0.0878	0.0691	0.0621	0.0603	0.0931
2	0.1582	0.3771	0.3291	0.3688	0.3944	**2**	0.0660	0.0555	0.0606	0.0569	0.0606
3	0.2410	0.2756	0.3649	0.4082	0.4475	**3**	0.0641	0.0527	0.0525	0.0523	0.0562
4	0.3357	0.4408	0.3982	0.4284	0.4533	**4**	0.0467	0.0469	0.0515	0.0495	0.0604
Small	0.4117	0.3951	0.4236	0.7826	0.3922	**Small**	0.0447	0.0810	0.0589	0.0690	0.0613

Panel 5: Two-factor Liu (2006) model (1 Month Rebalance)

Alpha						**t-statistics**					
	High	**2**	**3**	**4**	**Low**		**1**	**2**	**3**	**4**	**5**
Big	0.0470	0.0367	0.0335	0.0401	0.0527	**Big**	5.88	4.65	4.34	5.53	6.28

2	0.0272	0.0246	0.0307	0.0282	0.0275	**2**	4.73	3.94	4.04	3.96	4.00
3	0.0202	0.0188	0.0237	0.0246	0.0262	**3**	3.32	3.60	4.01	4.09	4.09
4	0.0160	0.0160	0.0202	0.0175	0.0268	**4**	3.46	3.22	3.45	3.44	4.13
Small	0.0084	0.0063	0.0039	0.0025	0.0146	**Small**	1.87	1.08	0.66	0.59	2.41

Market Beta						**t-statistics**					
	High	**2**	**3**	**4**	**Low**		**High**	**2**	**3**	**4**	**Low**
Big	0.2511	0.1918	0.1793	0.2466	0.2286	**Big**	2.10	1.75	2.04	2.34	1.77
2	0.2149	0.2515	0.2088	0.2022	0.2477	**2**	1.81	2.33	1.77	1.91	1.97
3	0.2381	0.2166	0.2253	0.2516	0.2581	**3**	1.77	1.95	2.07	2.27	1.94
4	0.2140	0.2395	0.2473	0.2565	0.2607	**4**	2.18	2.13	2.40	2.46	1.87
Small	0.2089	0.5017	0.2872	1.0708	0.2142	**Small**	2.09	2.33	2.20	4.72	1.58

HML Beta						**t-statistics**					
	High	**2**	**3**	**4**	**Low**		**High**	**2**	**3**	**4**	**Low**
Big	0.0076	-0.0167	-0.1717	-0.1568	-0.1405	**Big**	0.06	-0.14	-2.07	-1.92	-1.12
2	0.1930	-0.1119	-0.1940	-0.2480	-0.2067	**2**	2.20	-1.40	-2.04	-2.79	-2.19
3	0.0944	0.0824	-0.0980	-0.1485	-0.1841	**3**	0.89	1.13	-1.18	-1.67	-1.83
4	0.0341	-0.0575	-0.0842	-0.1388	-0.2510	**4**	0.59	-0.72	-1.03	-1.65	-2.22
Small	-0.0702	0.0348	-0.1636	-0.0259	-0.1682	**Small**	-1.13	0.35	-2.06	-0.22	-1.63

R-squared						**Standard Error**					
	High	**2**	**3**	**4**	**Low**		**High**	**2**	**3**	**4**	**Low**
Big	0.0836	0.0786	0.1134	0.1757	0.0713	**Big**	0.0931	0.0739	0.0681	0.0684	0.1004
2	0.1337	0.1954	0.1483	0.1762	0.1824	**2**	0.0669	0.0631	0.0683	0.0650	0.0704
3	0.1385	0.1639	0.1766	0.2229	0.1996	**3**	0.0683	0.0566	0.0598	0.0600	0.0676
4	0.1870	0.2093	0.2051	0.2463	0.1966	**4**	0.0516	0.0558	0.0592	0.0568	0.0732
Small	0.1881	0.3210	0.2215	0.7471	0.1272	**Small**	0.0526	0.0858	0.0684	0.0745	0.0734

**p<0.05; †p<0.01; ††p<0.005; HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 5.0000)

Table 7. Empirical results for 10 liquidity (1 year sort) decile portfolios – for Aggregate Asian regional market universe

This table provides the beta coefficients against valuation factors alongside their respective t-statistics, explanatory power (R-squared) and standard errors for the Fama and French (1993) three factor model (including size and book to market value), Carhart (1997) four factor model (including size, book to market value and momentum terms) and two factor liquidity model of Liu (2006) in modelling returns of 10 liquidity sorted quintile portfolios (formed from single-pass stock sorting technique of Liu (2006)). D1 is lowest illiquidity while D10 is highest illiquidity. These portfolios are formed from annual rebalancing using liquidity metric.

	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D10 - D1
Panel 1: CAPM											
Alpha (%)	0.014	0.012	0.010	0.008	0.011	0.009	0.007	0.005	0.011	0.007	-0.007
	[2.74]	[2.69]	[2.37]	[2.20]	[2.40]	[2.15]	[1.14]	[0.52]	[1.69]	[1.34]	[-0.92]
Beta: Market	0.305	0.330	0.256	0.280	0.299	0.263	0.324	0.550	0.393	1.088	0.783
	[2.39]	[2.42]	[2.16]	[3.13]	[2.83]	[2.13]	[1.93]	[2.55]	[3.53]	[4.53]	[2.62]
Adjusted R^2 (1)	0.2213	0.2523	0.1984	0.2843	0.2161	0.1725	0.1524	0.1773	0.2728	0.6089	0.3232
Panel 2: FF											
Alpha (%)	0.007	0.007	0.005	0.003	0.006	0.005	0.007	0.015	0.004	0.015	0.007
	[1.20]	[1.20]	[0.89]	[0.71]	[1.26]	[0.87]	[1.01]	[1.60]	[0.62]	[1.24]	[0.56]
Beta: Market	0.421	0.462	0.361	0.359	0.403	0.392	0.419	0.611	0.567	0.948	0.527
	[3.04]	[3.33]	[3.01]	[3.73]	[4.37]	[3.70]	[2.20]	[2.97]	[4.08]	[6.04]	[4.33]
Beta: SMB	0.257	0.258	0.226	0.203	0.208	0.217	0.070	-0.220	0.304	-0.319	-0.576
	[1.97]	[1.96]	[1.98]	[1.83]	[2.08]	[2.04]	[0.33]	[-0.67]	2.23]	[-0.82]	[-1.29]
Beta: HML	-0.219	-0.306	-0.208	-0.098	-0.232	-0.362	-0.434	-0.762	-0.471	0.242	0.462
	[-1.66]	[-2.29]	[-1.82]	[-0.86]	[-1.98]	[-3.27]	[-2.90]	[-2.21]	[-3.96]	[0.73]	[1.12]
Adjusted R^2 (3)	0.2618	0.3122	0.2416	0.3094	0.2500	0.2473	0.1995	0.2468	0.3688	0.6191	0.3673
Panel 3: FF + Mom											
Alpha (%)	0.008	0.007	0.005	0.003	0.006	0.005	0.006	0.014	0.004	0.014	0.007
	[1.23]	[1.23]	[0.92]	[0.77]	[1.26]	[0.93]	[0.92]	[1.55]	[0.55]	[1.20]	[0.51]
Beta: Market	0.422	0.463	0.361	0.360	0.403	0.392	0.417	0.609	0.566	0.947	0.525
	[3.04]	[3.32]	[3.00]	[3.77]	[4.36]	[3.67]	[2.23]	[3.06]	[4.15]	[6.28]	[4.79]
Beta: SMB	0.275	0.278	0.242	0.234	0.212	0.235	0.035	-0.270	0.277	-0.361	-0.636
	[2.04]	[2.03]	[2.05]	[2.07]	[2.01]	[2.04]	[0.18]	[-0.87]	[2.20]	[-0.94]	[-1.43]
Beta: HML	-0.212	-0.298	-0.201	-0.086	-0.230	-0.354	-0.448	-0.782	-0.482	0.225	0.436
	[-1.72]	[-2.42]	[-1.89]	[-0.81]	[-2.01]	[-3.41]	[-2.99]	[-2.29]	[-4.02]	[0.69]	[1.11]
Beta: Momentum	-0.097	-0.105	-0.088	-0.166	-0.022	-0.098	0.186	0.269	0.146	0.225	0.323
	[-1.03]	[-0.84]	[-0.86]	[-2.15]	[-0.28]	[-0.83]	[1.46]	[1.78]	[1.31]	[2.30]	[2.25]
Adjusted R^2 (4)	0.2644	0.3159	0.2444	0.3369	0.2457	0.2504	0.2109	0.2558	0.3768	0.6249	0.3808
Panel 4: Liquidity (1y)											
Alpha (%)	0.011	0.010	0.008	0.007	0.010	0.008	0.006	0.004	0.011	0.011	-- --
	[2.91]	[2.91]	[2.55]	[2.06]	[2.23]	[2.06]	[1.01]	[0.42]	[1.65]	[2.91]	
Beta: Market	0.561	0.572	0.459	0.436	0.473	0.461	0.427	0.656	0.398	0.561	-- --

	[4.48]	[4.58]	[4.28]	[5.04]	[5.81]	[4.99]	[2.57]	[2.90]	[3.49]	[4.48]	
Beta: Liquidity	-0.328	-0.308	-0.260	-0.200	-0.221	-0.252	-0.132	-0.136	-0.006	0.672	-- --
	[-5.15]	[-6.33]	[-5.87]	[-5.68]	[-9.33]	[-9.41]	[-2.69]	[-1.62]	[-0.11]	[10.56]	
Adjusted R^2 (2)	0.5501	0.5323	0.4608	0.4678	0.3654	0.3750	0.1803	0.1863	0.2684	0.9046	-- --
Panel 5: Liquidity (1m)											
Alpha (%)	0.012	0.011	0.009	0.007	0.011	0.009	0.008	0.006	0.012	0.011	-0.001
	[2.43]	[2.42]	[2.15]	[1.93]	[2.20]	[1.99]	[1.31]	[0.61]	[1.82]	[2.28]	[-0.12]
Beta: Market	0.246	0.295	0.230	0.257	0.283	0.246	0.353	0.577	0.425	1.197	0.951
	[1.96]	[2.17]	[1.96]	[2.90]	[2.56]	[1.94]	[2.03]	[2.66]	[3.80]	[5.09]	[3.27]
Beta: Liquidity	-0.411	-0.246	-0.182	-0.158	-0.118	-0.121	0.205	0.192	0.224	0.770	1.182
	[-4.15]	[-2.18]	[-2.04]	[-2.41]	[-1.49]	[-1.62]	[2.15]	[1.70]	[2.14]	[4.89]	[5.99]
Adjusted R^2 (2)	0.3714	0.3012	0.2320	0.3147	0.2242	0.1815	0.1709	0.1805	0.3022	0.7217	0.5990
Panel 6: All factors											
Alpha (%)	0.010	0.009	0.007	0.005	0.008	0.006	0.007	0.015	0.003	0.010	-- --
	[1.77]	[1.92]	[1.62]	[1.08]	[1.45]	[1.29]	[1.06]	[1.58]	[0.51]	[1.77]	
Beta: Market	0.588	0.614	0.490	0.456	0.513	0.511	0.483	0.681	0.544	0.588	-- --
	[3.97]	[4.23]	[3.92]	[4.51]	[5.43]	[4.63]	[2.52]	[3.22]	[3.84]	[3.97]	
Beta: SMB	0.073	0.094	0.086	0.118	0.079	0.092	-0.044	-0.358	0.304	0.073	-- --
	[0.61]	[0.76]	[0.72]	[1.27]	[0.91]	[0.78]	[-0.21]	[-1.04]	[2.38]	[0.61]	
Beta: HML	-0.073	-0.173	-0.094	-0.006	-0.139	-0.256	-0.394	-0.722	-0.501	-0.073	-- --
	[-0.81]	[-1.95]	[-1.06]	[-0.08]	[-1.94]	[-3.14]	[-2.47]	[-2.01]	[-4.17]	[-0.81]	
Beta: Momentum	0.005	-0.012	-0.009	-0.107	0.045	-0.025	0.227	0.313	0.133	0.005	-- --
	[0.07]	[-0.12]	[-0.1]	[-1.38]	[0.66]	[-0.20]	[1.80]	[2.05]	[1.18]	[0.07]	
Beta: Liquidity	-0.317	-0.288	-0.246	-0.183	-0.209	-0.226	-0.124	-0.138	0.042	0.683	-- --
	[-4.85]	[-5.79]	[-5.32]	[-4.74]	[-7.73]	[-7.42]	[-2.30]	[-1.22]	[0.94]	[10.44]	
Adjusted R^2 (5)	0.5460	0.5396	0.4592	0.4764	0.3665	0.3984	0.2331	0.2644	0.3766	0.9037	-- --

Notes: (1) Numbers in parentheses are t-statistics; (2) 10 year US Treasury yield taken as risk free rate; (3) **p<0.05; †p<0.01; ††p<0.005; (4) HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 5.0000)

Table 8 Time series regression tests on CAPM and multifactor models using monthly excess returns for decile liquidity-sorted portfolios through annual and monthly rebalancing, momentum and country portfolios for period January 2000 – August 2014

The regressions use the CAPM, three factor Fama and French (1993) size and book-to-market augmented CAPM, Carhart (1997) four-factor CAPM including size, book-to-market and momentum factors and the Liu (2006) two factor liquidity-augmented CAPM which uses two separate liquidity factors – one from annual rebalancing and holding periods and the second from monthly rebalancing and annual holding periods. The GRS statistic tests whether all intercepts in a set of test portfolios (assets) regressions are zero; |a| is the average absolute intercept for a set of regressions; R^2 is the average adjusted R^2, SE(model) is the average standard error of the overall models. In order to avoid collinearity issues in estimation we have dropped the extreme D1 and D10 portfolios in each case – where these have been used to form the aggregate returns-based valuation factors. Collinearity is an issue given the GRS statistic is of the same dimensions as factors – in being focussed on cross section of stock returns. Collinearity concerns are also behind the dropping of 25 quintile 5x5 sorted portfolios from the Fama and French size and book-to-market value sorting process too – as the formation of factors are based on many sub-portfolios formed from within the sorting process. Collinearity is not a problem in the country (individual market) portfolios.

Panel 1: Asia Japan only	**Decile (Liquidity-1y) portfolios**				**Decile (Liquidity-1m) portfolios**			
	R^2	SE(model)	|a|	GRS	R^2	SE(model)	|a|	GRS
CAPM	0.3464	0.0402	0.0048	15.47††	0.3075	0.0447	0.0050	9.29††
FF3F CAPM	0.4933	0.0364	0.0020	8.76††	0.4525	0.0408	0.0032	6.65††
Carhart 4F (incl mom) CAPM	0.4914	0.0364	0.0020	9.83††	0.4505	0.0409	0.0032	7.06††
Liquidity (1yr) 2F CAPM	0.4119	0.0382	0.0049	15.44††	0.3660	0.0429	0.0050	9.33††
Liquidity (1m) 2F CAPM	0.4119	0.0382	0.0049	15.54††	0.3475	0.0436	0.0048	9.51††
5F CAPM	0.5294	0.0349	0.0018	23.65††	0.4915	0.0392	0.0022	45.54††
	Decile (Momentum) portfolios				**Country portfolios**			
	R^2	SE(model)	|a|	GRS	R^2	SE(model)	|a|	GRS
CAPM	0.5691	0.0315	0.0043	9.42††	0.3837	0.0592	0.0046	14.29††
FF3F CAPM	0.5776	0.0312	0.0038	11.72††	0.4531	0.0567	0.0033	11.64††
Carhart 4F (incl mom) CAPM	0.5915	0.0307	0.0037	11.67††	0.4508	0.0568	0.0034	11.86††
Liquidity (1yr) 2F CAPM	0.6195	0.0292	0.0045	10.39††	0.4089	0.0574	0.0051	19.17††
Liquidity (1m) 2F CAPM	0.5805	0.0307	0.0051	10.89††	0.3833	0.0589	0.0048	19.31††
5F CAPM	0.6669	0.0274	0.0025	13.34††	0.4962	0.0543	0.0042	12.48††

Panel 2: Asia excluding Japan	**Decile (Liquidity-1y) portfolios**				**Decile (Liquidity-1m) portfolios**			
	R^2	SE(model)	|a|	GRS	R^2	SE(model)	|a|	GRS
CAPM	0.2132	0.0660	0.0116	13.28††	0.2205	0.0779	0.0116	13.35††
FF3F CAPM	0.2909	0.0629	0.0030	6.84††	0.2932	0.0747	0.0040	5.26††
Carhart 4F (incl mom) CAPM	0.2958	0.0627	0.0033	12.62††	0.2996	0.0745	0.0046	12.58††
Liquidity (1yr) 2F CAPM	0.4000	0.0583	0.0093	14.32††	0.3862	0.0694	0.0100	13.77††
Liquidity (1m) 2F CAPM	0.2346	0.0650	0.0114	12.96††	0.2357	0.0770	0.0116	13.09††
5F CAPM	0.4329	0.0568	0.0041	21.17††	0.4184	0.0680	0.0048	43.68††
	Decile (Momentum) portfolios				**Country portfolios**			
	R^2	SE(model)	|a|	GRS	R^2	SE(model)	|a|	GRS
CAPM	0.3269	0.0523	0.0113	16.55††	0.1345	0.0755	0.0160	50.94††
FF3F CAPM	0.3711	0.0506	0.0038	8.46††	0.2157	0.0714	0.0051	22.10††
Carhart 4F (incl mom) CAPM	0.4039	0.0492	0.0046	12.00††	0.2214	0.0711	0.0058	73,262.59††
Liquidity (1yr) 2F CAPM	0.5465	0.0424	0.0097	16.66††	0.2716	0.0685	0.0138	55.37††
Liquidity (1m) 2F CAPM	0.3634	0.0499	0.0115	17.17††	0.1807	0.0726	0.0153	54.11††

5F CAPM	0.5838	0.0407	0.0047	23.46††	0.3153	0.0664	0.0062	47.03††
Panel 3: Asia overall	**Decile (Liquidity-1y) portfolios**				**Decile (Liquidity-1m) portfolios**			
	R^2	SE(model)	|a|	GRS	R^2	SE(model)	|a|	GRS
CAPM	0.2157	0.0646	0.0092	10.27††	0.2051	0.0840	0.0084	11.73††
FF3F CAPM	0.2719	0.0622	0.0063	4.43††	0.2297	0.0828	0.0062	6.10††
Carhart 4F (incl mom) CAPM	0.2795	0.0618	0.0062	6.10††	0.2335	0.0827	0.0062	8.60††
Liquidity (1yr) 2F CAPM	0.3545	0.0594	0.0079	11.43††	0.3344	0.0778	0.0077	11.91††
Liquidity (1m) 2F CAPM	0.2383	0.0638	0.0090	9.78††	0.2267	0.0830	0.0084	11.19††
5F CAPM	0.3892	0.0576	0.0074	14.84††	0.3416	0.0773	0.0068	14.11††
	Decile (Momentum) portfolios				**Country portfolios**			
	R^2	SE(model)	|a|	GRS	R^2	SE(model)	|a|	GRS
CAPM	0.3574	0.0443	0.0085	10.81††	0.1189	0.0756	0.0141	66.17††
FF3F CAPM	0.3817	0.0435	0.0065	18.52††	0.1764	0.0727	0.0094	39.72††
Carhart 4F (incl mom) CAPM	0.4153	0.0423	0.0067	27.97††	0.1873	0.0722	0.0096	44,107.40††
Liquidity (1yr) 2F CAPM	0.5400	0.0371	0.0078	11.34††	0.2375	0.0698	0.0122	74.54††
Liquidity (1m) 2F CAPM	0.3993	0.0421	0.0083	10.52††	0.1650	0.0730	0.0129	71.34††
5F CAPM	0.5765	0.0357	0.0074	12.77††	0.2743	0.0681	0.0098	69.99††

Notes: **p<0.05; †p<0.01; ††p<0.005; (4) HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 5.0000)

Table 9 Time varying parameter model tests on CAPM-type and multifactor models using monthly excess returns for decile liquidity-sorted portfolios through annual and monthly rebalancing, momentum and country portfolios for period January 2000 – August 2014

This table reports the average time varying alpha terms, proportions of sample for which the lower standard error band is negative (i.e. inferring the alpha lacks statistical significance while negative) and proportions of testing asset portfolios (deciles or quintile portfolios) for which convergence is achieved. Time-varying parameter Kalman filter CAPM-type and multifactor CAPM-based models are used where these are based on CAPM, three factor Fama and French (1993) Size and Book-to-Market augmented CAPM, Liu (2006) two factor liquidity-augmented CAPM. ** denotes the largest (most negative) value of Aikake information criterion (i.e. the best performing model in accordance to this informational criterion)

	Time series		**Final state**		**AIC criterion**	**Time series**		**Final state**		**AIC criterion**
	Mean alpha	**% SE (alpha) negative**	**Mean alpha**	**Mean alpha z-statistic**		**Mean alpha**	**% SE (alpha) negative**	**Mean alpha**	**Mean alpha z-statistic**	
Panel 1: Asia Japan only	Decile (Liquidity-1y) portfolios					Decile (Liquidity-1m) portfolios				
CAPM	0.00745	91.18%	0.00418	0.08785	-2.5685	0.00772	91.12%	0.00406	0.05694	-2.2254
FF3F CAPM	0.00378	91.12%	-0.00301	-0.07738	-2.5926	0.00346	91.25%	0.00130	-0.02255	-2.2030
Carhart 4F (incl mom) CAPM	0.00365	90.39%	0.00026	0.05869	-2.5189	0.00262	89.21%	0.00298	0.09312	-2.1471
Liquidity (1yr) 2F CAPM	0.00711	89.41%	0.00264	0.08730	-2.8569**	0.00792	89.80%	0.00294	0.06751	-2.3781**
Liquidity (1m) 2F CAPM	0.00663	90.79%	0.00221	0.05047	-2.6899	0.00738	90.86%	0.00265	0.04797	-2.3408
5F CAPM	0.00388	88.36%	0.00113	0.13578	-2.7731	0.00500	79.47%	0.00135	0.00420	-2.2766
	Decile (Momentum) portfolios					Quintiles portfolios				
CAPM	0.00407	92.11%	0.00522	0.19303	-3.4713	0.00939	89.32%	0.02911	0.49809	-2.5608
FF3F CAPM	0.00603	82.96%	0.00815	0.33558	-3.2109	0.00383	90.71%	0.00819	0.17783	-2.8834**
Carhart 4F (incl mom) CAPM	0.00261	84.47%	0.00316	0.55804	-3.3008	0.00427	90.33%	0.00434	0.08561	-2.7799
Liquidity (1yr) 2F CAPM	0.00645	89.93%	0.00354	0.14081	-3.3255	0.00977	88.08%	0.02639	0.50756	-2.5010
Liquidity (1m) 2F CAPM	0.00647	90.46%	0.00295	0.06364	-3.1571	0.00991	88.26%	0.02816	0.53688	-2.4517
5F CAPM	0.00278	82.83%	0.00345	0.63133	-3.4950**	0.00449	88.69%	0.00776	0.23022	-2.7329
Panel 2: Asia excluding Japan	Decile (Liquidity-1y) portfolios					Decile (Liquidity-1m) portfolios				
CAPM	0.00745	91.18%	0.00418	0.08785	-2.5685	0.00772	91.12%	0.00406	0.05694	-2.2254
FF3F CAPM	0.00378	91.12%	-0.00301	-0.07738	-2.5926	0.00346	91.25%	0.00130	-0.02255	-2.2030
Carhart 4F (incl mom) CAPM	0.00365	90.39%	0.00026	0.05869	-2.5189	0.00262	89.21%	0.00298	0.09312	-2.1471
Liquidity (1yr) 2F CAPM	0.00645	89.93%	0.00354	0.14081	-3.3255**	0.00792	89.80%	0.00154	0.04017	-2.3686**
Liquidity (1m) 2F CAPM	0.00647	90.46%	0.00295	0.06364	-3.1571	0.00738	90.86%	0.00265	0.04797	-2.3408
5F CAPM	0.00388	88.36%	0.00113	0.13578	-2.7731	0.00530	88.55%	0.00135	0.00420	-2.2766
	Decile (Momentum) portfolios					Quintiles portfolios				
CAPM	0.00679	91.91%	0.00363	0.04780	-3.0027	0.02090	84.72%	0.01449	0.25834	-2.4317
FF3F CAPM	0.00267	93.29%	0.00353	0.12753	-3.1363	0.00568	88.71%	0.00537	0.13006	-2.6330**
Carhart 4F (incl mom) CAPM	0.00261	84.47%	0.00316	0.55804	-3.3008	0.00570	87.15%	0.00564	0.18386	-2.5356
Liquidity (1yr) 2F CAPM	0.00482	89.28%	0.00462	0.22955	-3.4048	0.02056	83.93%	0.01262	0.24512	-2.4533

Liquidity (1m) 2F CAPM	0.00477	91.64%	0.00423	0.15060	-3.2507	0.01978	84.99%	0.01162	0.22427	-2.3961
5F CAPM	0.00278	82.83%	0.00345	0.63133	-3.4950**	0.00491	84.82%	0.00568	0.28038	-2.5414
Panel 3: Asia overall	Decile (Liquidity-1y) portfolios					Decile (Liquidity-1m) portfolios				
CAPM	0.00668	91.38%	0.00714	0.14930	-2.5028	0.00605	91.84%	0.00716	0.12399	-2.0577
FF3F CAPM	0.00787	90.66%	0.01132	0.32545	-2.4206	0.00490	92.57%	0.00430	0.13258	-1.9666
Carhart 4F (incl mom) CAPM	0.00749	89.74%	0.00852	0.28489	-2.3767	0.00793	99.87%	0.00684	0.01027	-9.1768**
Liquidity (1yr) 2F CAPM	0.00623	91.64%	0.00622	0.21892	-2.7349**	0.00574	91.97%	0.00665	0.18165	-2.2268
Liquidity (1m) 2F CAPM	0.00585	90.26%	0.00480	0.15269	-2.5675	0.00557	92.57%	0.00547	0.16292	-2.1554
5F CAPM	0.00415	88.82%	0.00569	0.28198	-2.6450	0.00468	91.25%	0.00387	0.18478	-2.0611
	Decile (Momentum) portfolios					Quintiles portfolios				
CAPM	0.00559	91.64%	0.00508	0.13835	-3.1602	0.01898	84.99%	0.01703	0.30627	-2.5773
FF3F CAPM	0.00443	90.66%	0.00151	0.11288	-3.1921	0.00828	84.79%	0.00717	0.20618	-2.6833**
Carhart 4F (incl mom) CAPM	0.00469	88.95%	0.00340	0.22697	-3.2551	0.00648	85.50%	0.00792	0.32158	-2.6475
Liquidity (1yr) 2F CAPM	0.00482	89.28%	0.00462	0.22955	-3.4048**	0.01876	83.40%	0.01609	0.33693	-2.5876
Liquidity (1m) 2F CAPM	0.00477	91.64%	0.00423	0.15060	-3.2507	0.01773	83.93%	0.01392	0.27321	-2.5355
5F CAPM	0.00284	80.86%	0.00317	0.42938	-3.5207	0.00545	83.83%	0.00820	0.33679	-2.6633

Appendix Table 1. Datastream variable definitions

All data was sourced from Datastream and Worldscope (accessed through Datastream portal)

Variable	Definition	Datastream/ Bloomberg Mnemonic
Datastream items		
Total Returns	A return index (RI) is available for individual equities and unit trusts. This shows a theoretical growth in value of a share-holding over a specified period, assuming that dividends are re-invested to purchase additional units of an equity or unit trust at the closing price applicable on the ex-dividend date. Gross dividends are used where available and the calculation ignores tax and re-investment charges. Adjusted closing prices are used throughout to determine price index and hence return index	RI
Price	This is the adjusted default official daily closing price. It is denominated in primary units of local currency. Prices are generally based on 'last trade' or an official price fixing. The 'current' prices taken at the close of market are stored each day. These stored prices are adjusted for subsequent capital actions, and this adjusted figure then becomes the default price available	P
Book to Market Value	This is defined as the inverse of the market value of the ordinary (common) equity divided by the balance sheet value of the ordinary (common) equity in the company (Worldscope item 03501) which is available through Datastream	MTBV
Traded Volume	This shows the number of shares traded for a stock on a particular day. The data type is reported in thousands. Both daily and non-daily figures are adjusted for capital events. However, if a capital event occurs in the latest period of a non-daily request, then the volume for that particular period only is retrieved as unadjusted.	VO
Number of Shares	This is the total number of ordinary shares that represent the capital of the company. The data type is expressed in thousands.	NOSH
Bloomberg items		
Total Returns	This is defined as the total return index of stock incorporating the value of gross dividends. The US$ currency adjusted values are used.	TOT_RETURN_INDEX_GROSS_DVDS
Price	This is the "Last Price" which is the adjusted stock price of individual stock	PX_LAST
Book to Market Value	This is reported as the market capitalization to accounting book value ratio. To obtain the "Book to Market Value" ratio (as used in Fama and French (1993)) it is necessary to use the inverse of the ratio as reported in Bloomberg.	MARKET_CAPITALIZATION_TO_BV
Traded Volume	This is defined as the total number of shares traded on a particular day. The value is reported in units of shares.	PX_VOLUME
Number of Shares	The current total number of shares issued and outstanding is used. This is defined as the number of shares issued and outstanding and is expressed in millions	EQY_SH_OUT

Appendix Table 2. Bloomberg and Datastream variable definitions

All data was sourced from Bloomberg, Datastream and Worldscope (accessed through Datastream portal)

Coverage	Source	Index	Description	Datastream Mnemonic
Australasia				
Australia	DS	S&P/ASX 200	200 stocks. Source: S&P/ASX	LASX200I
New Zealand	DS	NZX 50	50 stocks. Source: New Zealand stock exchange	LNZ50CAP
Papua New Guinea	BBG	Papua New Guinea Overall	7 stocks. Source: Port Moresby stock exchange (via Bloomberg)	-- --
Fiji	BBG	Fiji Overall	16 stocks. Source: Pacific stock exchange (via Bloomberg)	-- --
Asia-Pacific				
Taiwan	DS	Taiwan Top 100	100 stocks. Source: Taiwan stock exchange	LTATP100
South Korea	DS	KOSPI 100	100 stocks. Source: Korea stock exchange	LKOR100I
Philippines	DS	Manila Composite	30 stocks. Source: Philippine stock exchange	LPSECOMP
Hong Kong	DS	S&P Hong Kong	200 stocks. Source: Standard & Poors	LSBBVHK$
Indonesia	DS	Jakarta LQ45 (Top 45)	45 stocks. Source: Indonesian stock exchange	LJAKLQ45
China: Shanghai	DS	Shanghai SE 180	180 stocks. Source: Shanghai stock exchange	LCHSH180
China: Shenzen	DS	Shenzhen SE 100	100 stocks. Source: Shenzhen stock exchange	LCHZH100
Malaysia	DS	Composite	100 stocks. Source: FTSE	LFBMKLCI 0901
Singapore	DS	TR Singapore (Composite)	184 stocks. Source: Thomson Reuters	LXSGFLDL
Thailand	DS	Bangkok SET 100	100 stocks. Source: Stock exchange of Thailand	LBNGK100
Vietnam	BBG	HOSE Vn100	100 stocks. Source: Ho Chi Minh stock exchange	-- --
Cambodia	BBG	Cambodia Overall	3 stocks. Source: Cambodian stock exchange	-- --
Laos	BBG	Laos Overall	3 stocks. Source: Laos stock exchange	-- --
Mongolia	BBG	Mongolia MSE-30	Stock data corresponding to the constituents of MSE-30 index (obtained from Mongolian stock exchange) are obtained from Bloomberg	-- --
Japan: Tokyo	DS	S&P TOPIX 150	150 stocks. Source Standard & Poors	LSPTOPIX
Japan: Sapporo	DS	Sapporo All listings	59 stocks. Source: Sapporo securities exchange	ASAPPORO
Japan: Osaka	DS	Combination of "First Market" segment and "Second Market" segment	44 stocks for "First Market" and 160 stocks for "Second Market". Source: Osaka securities exchange	OSAKA1 & OSAKA2
Japan: Fukuoka	DS	Fukoka Market	36 stocks. Source: Fukuoka stock exchange	FUKUOKA
Japan: Nagoya	DS	Combination of "First Market" segment and "Second Market" segment	13 stocks for "First Market" and 69 stocks for "Second Market". Source: Nagoya securities exchange	NAGOYA1 & NAGOYA2
South Asia				
India	DS	S&P BSE (100) National	100 stocks from across India. Source: S&P	LIBOMBSE
Pakistan	BBG	Karachi-100	100 stocks. Source Karachi stock exchange	-- --
Bangladesh	BBG	DS30	30 stocks. Source: Dhaka stock exchange	-- --
Nepal	BBG	Top 10 (by Mkt Cap)	10 stocks – selected from top 10 (by Mkt Cap) list obtained from NEPSE website. Source NEPSE (Kathmandu) (via Bloomberg)	-- --
Sri Lanka	DS	Dow Jones Titans	30 stocks: Source: Dow Jones (via DS)	
Central Asia				
Armenia	BBG	Armenia Overall	12 stocks. Source: Armenian stock exchange (via Bloomberg)	-- --
Azerbaijan	BBG	Azerbaijan Overall	187 stocks. Source: Baku stock exchange (via Bloomberg)	-- --
Kazakhstan	BBG	Kazakhstan Overall	78 stocks. Source: Kazakh stock exchange (via Bloomberg)	-- --
Indian Ocean				
Oman	DS	Oman General	25 stocks: Source: Muscat securities exchange	
Maldives	MSE*	Maldives Overall	7 stocks: Source Maldives stock exchange	-- --
Seychelles	BBG	Seychelles Overall	3 stocks. Source: Trop-X, Victoria, Seychelles	-- --
Mauritius	BBG	Main Board	40 stocks. Source: Stock Exchange of Mauritius	-- --

Notes: BBG refers to Bloomberg; DS to Datastream; *indicates data obtained direct from Maldives stock exchange

Figure 1 Vietnam (Alpha)

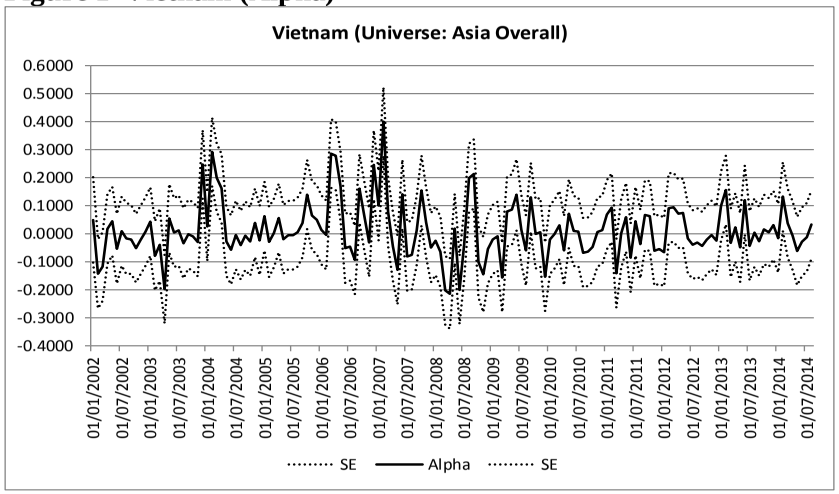

Figure 2 Vietnam (Beta Market)

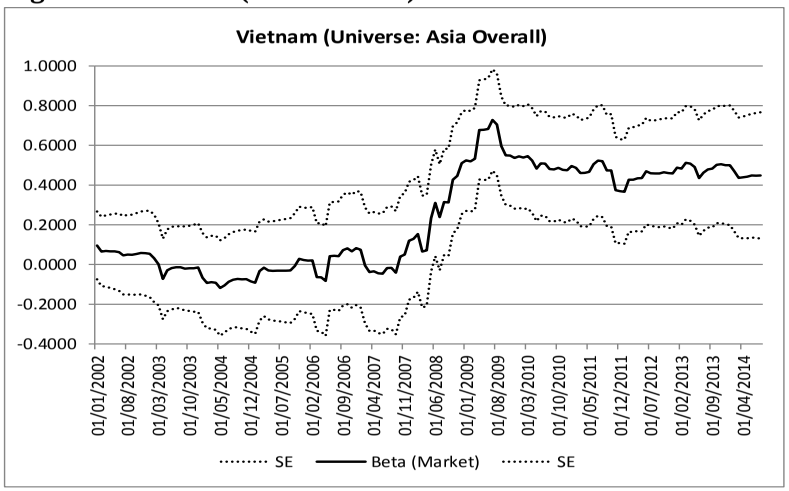

Figure 3 Vietnam (Beta Liquidity)

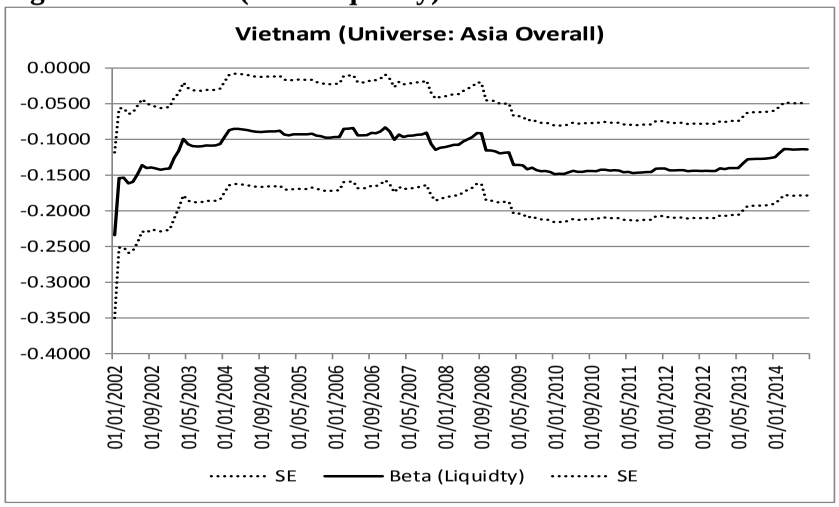

Figure 4 New Zealand (Alpha)

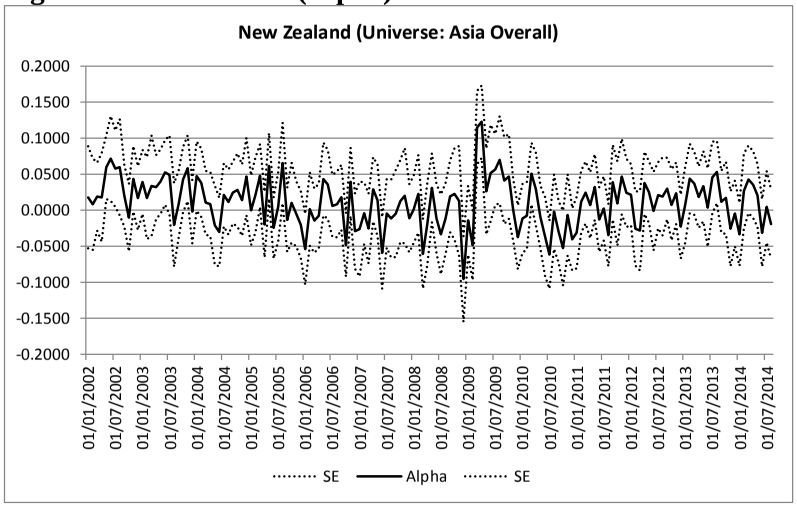

Figure 5 New Zealand (Beta Market)

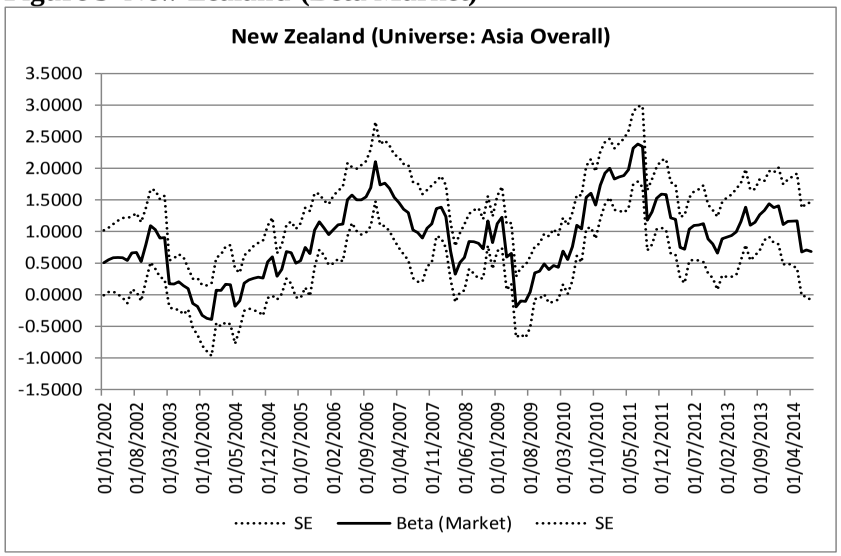

Figure 6 New Zealand (Beta Liquidity)

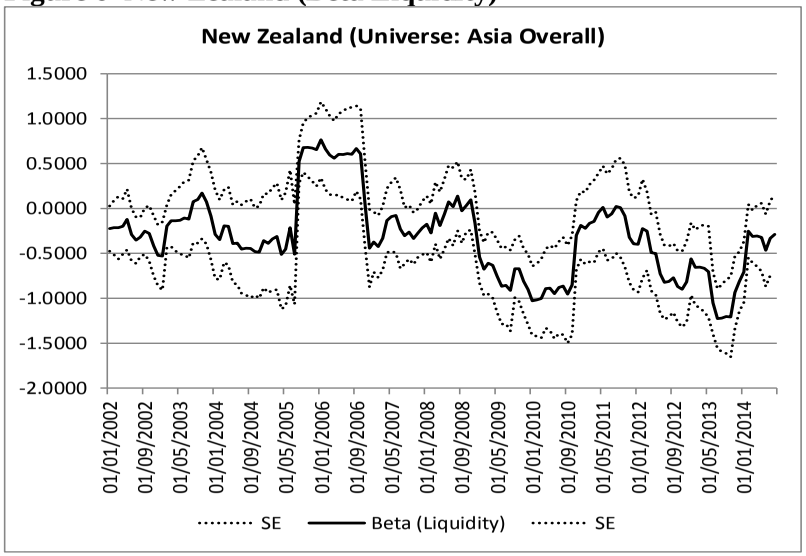

Figure 7 Hong Kong (Alpha)

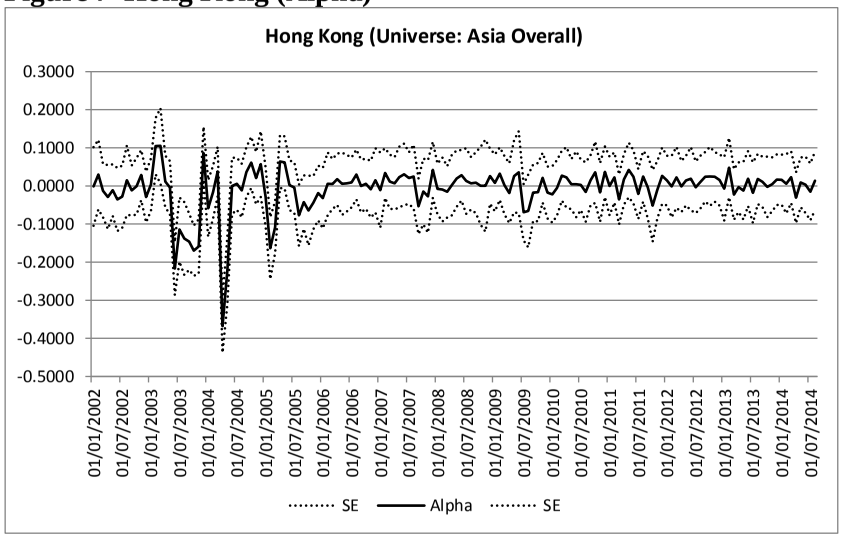

Figure 8 Hong Kong (Beta Market)

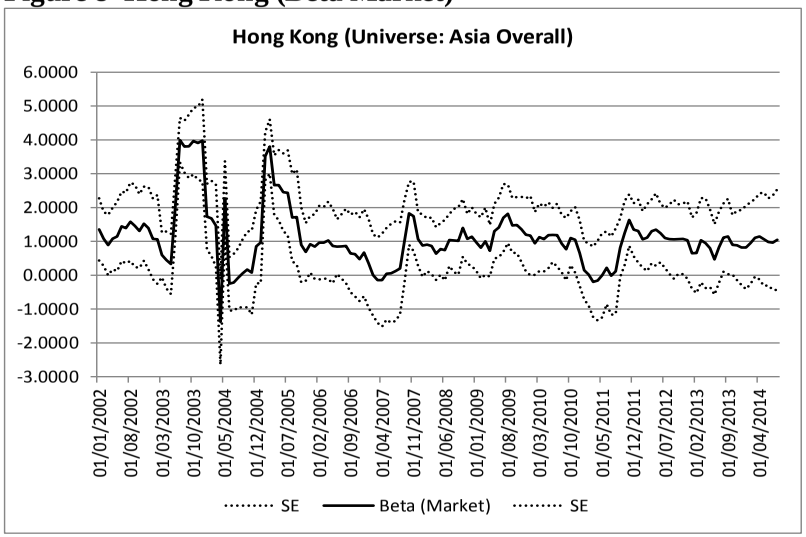

Figure 9 Hong Kong (Beta Liquidity)

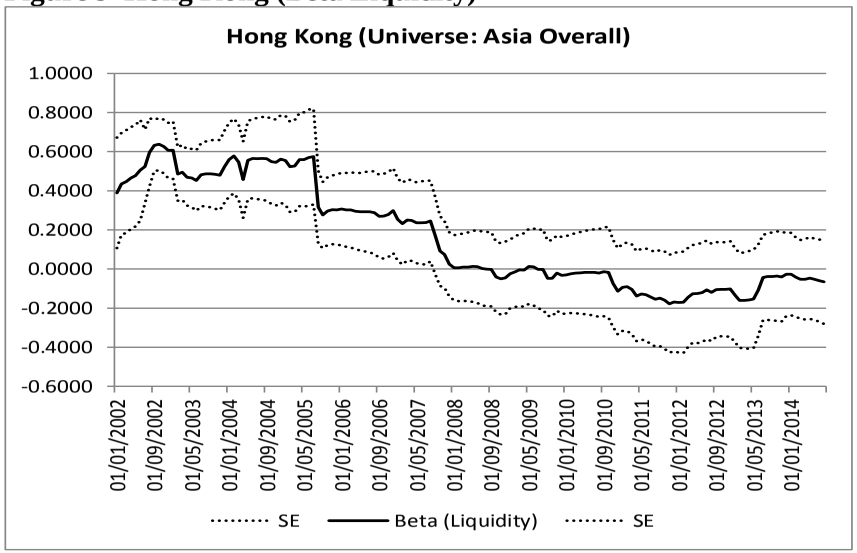

Figure 10 China Shanghai (Alpha)

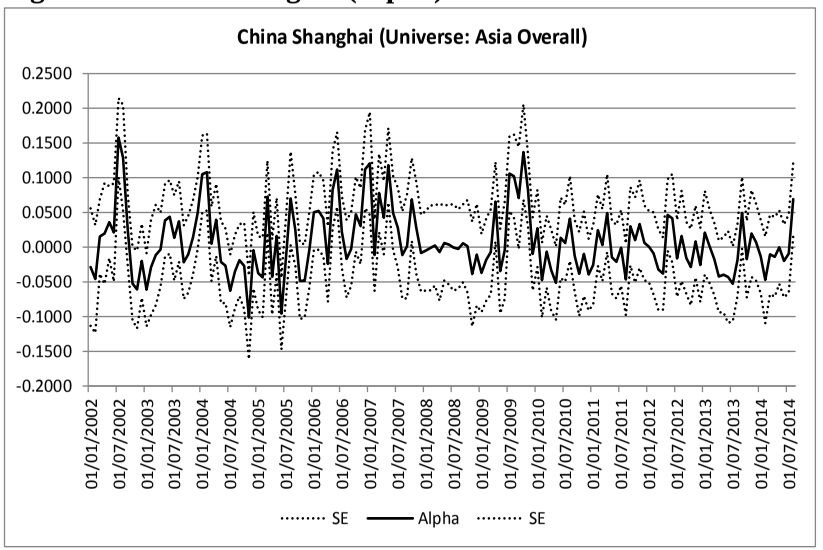

Figure 11 China Shanghai (Beta Market)

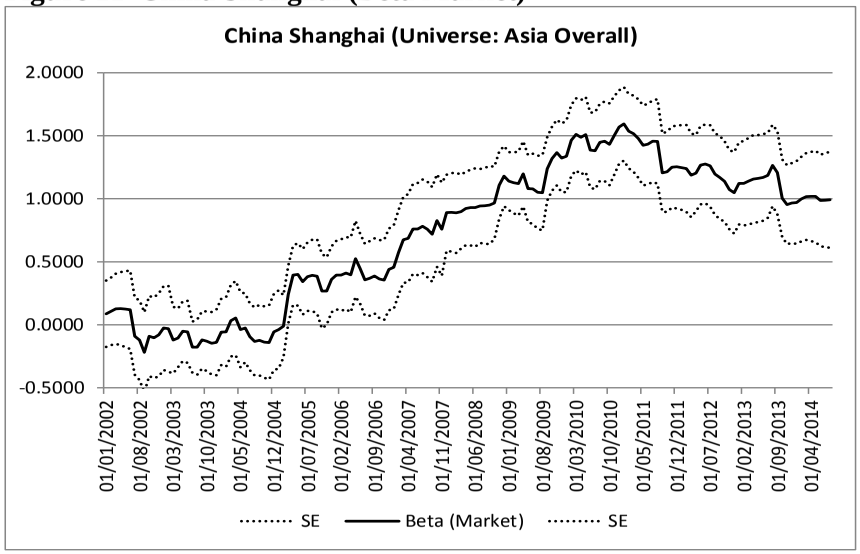

Figure 12 China Shanghai (Beta Liquidity)

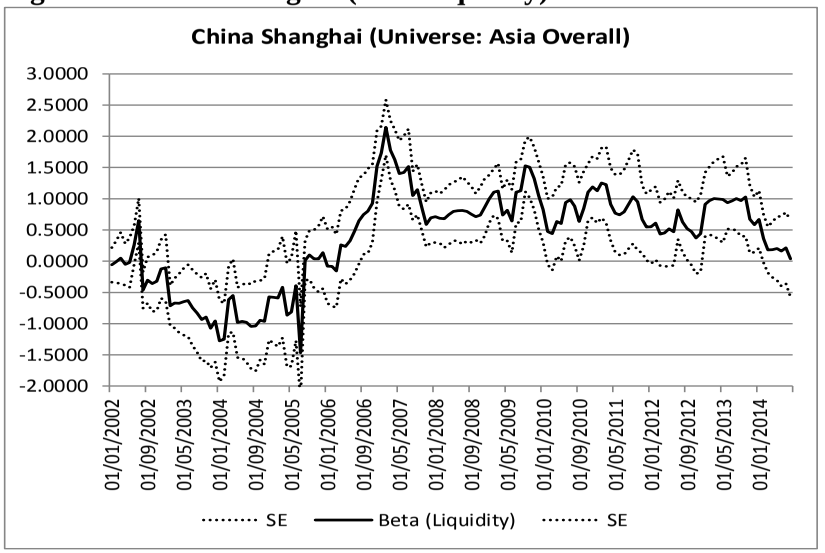

Figure 13 Malaysia (Asia overall universe) (Alpha)

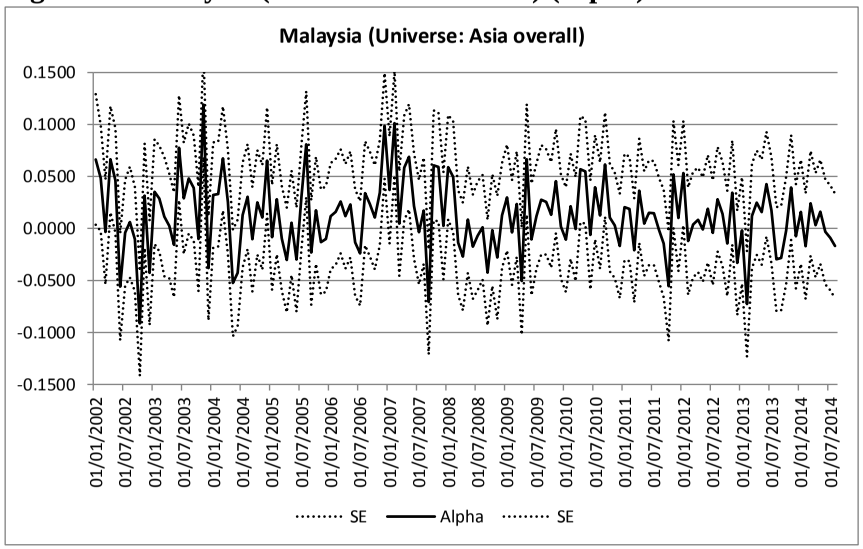

Figure 14 Malaysia (Asia overall universe) (Beta Market)

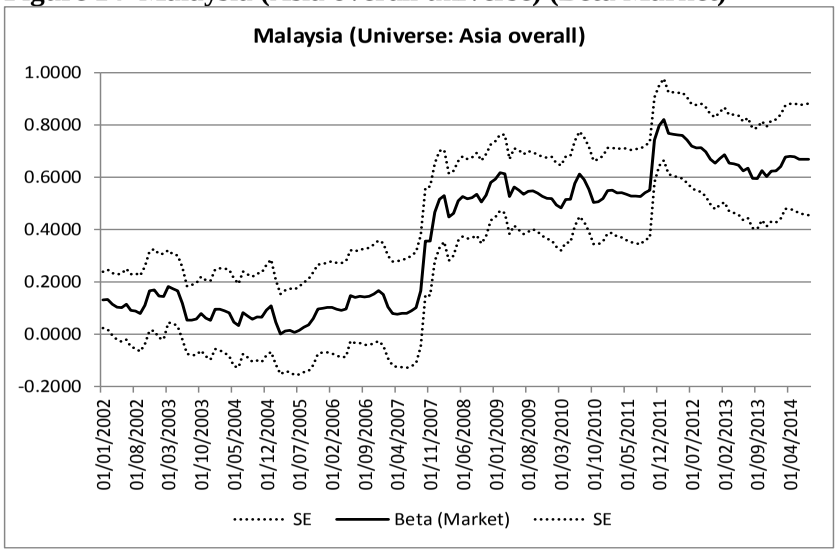

Figure 15 Malaysia (Asia overall universe) (Beta Liquidity)

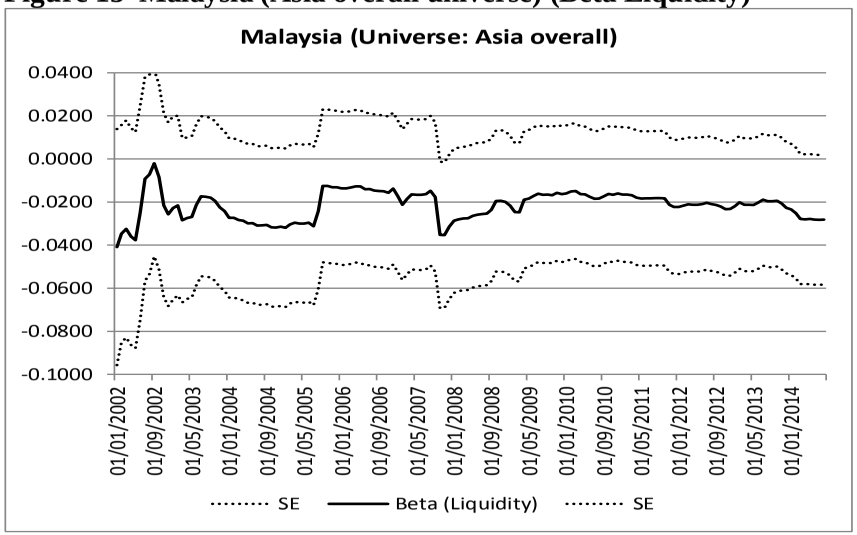

Figure 16 Maldives (Asia overall universe) (Alpha)

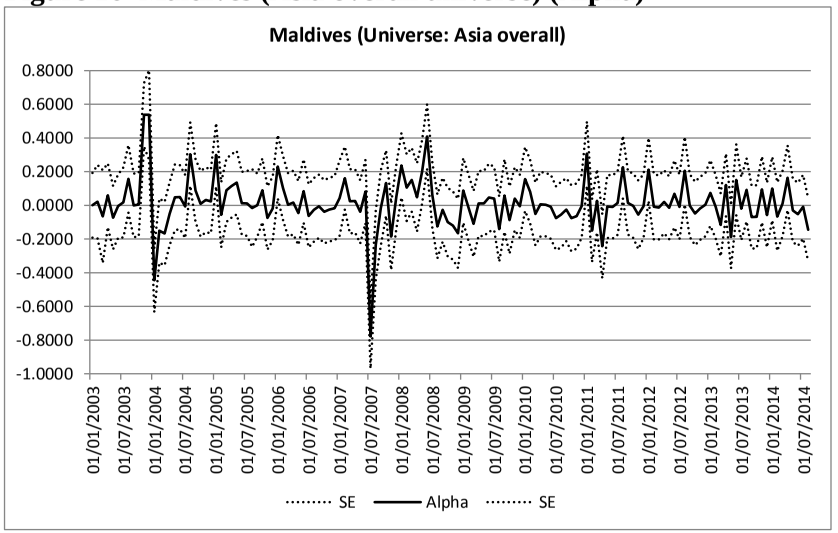

Figure 17 Maldives (Asia overall universe) (Beta Market)

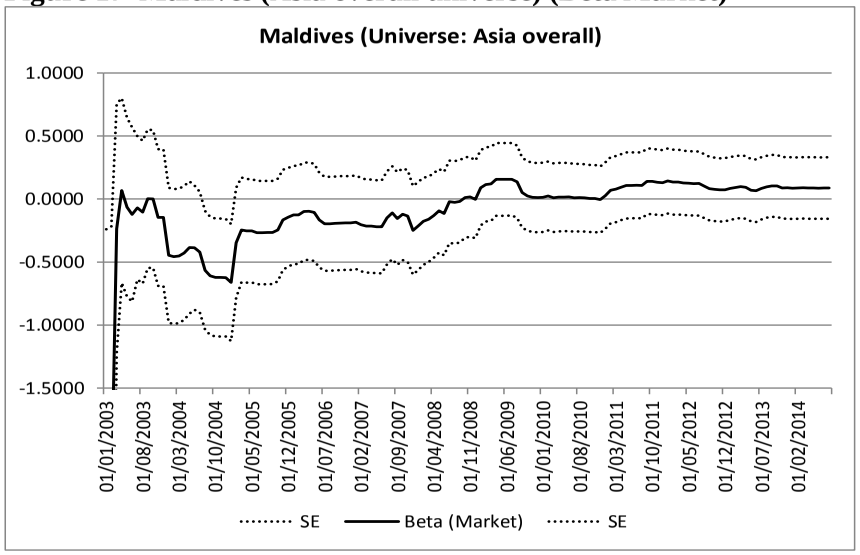

Figure 18 Maldives (Asia overall universe) (Beta Liquidity)

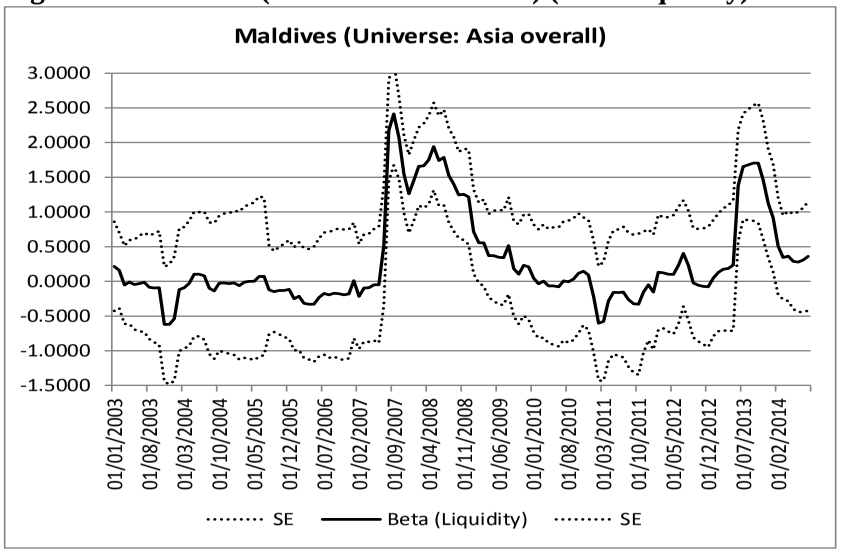

Figure 19 Mauritius (Asia overall universe) (Alpha)

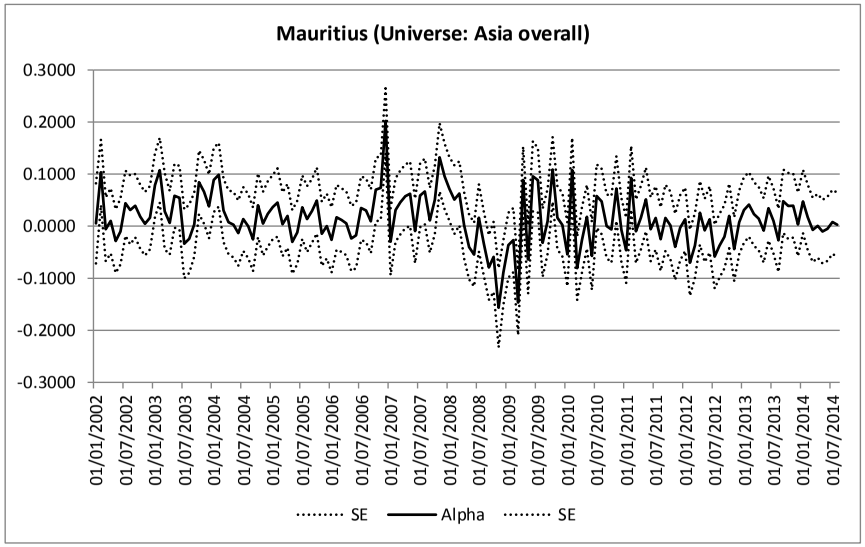

Figure 20 Mauritius (Asia overall universe) (Beta Market)

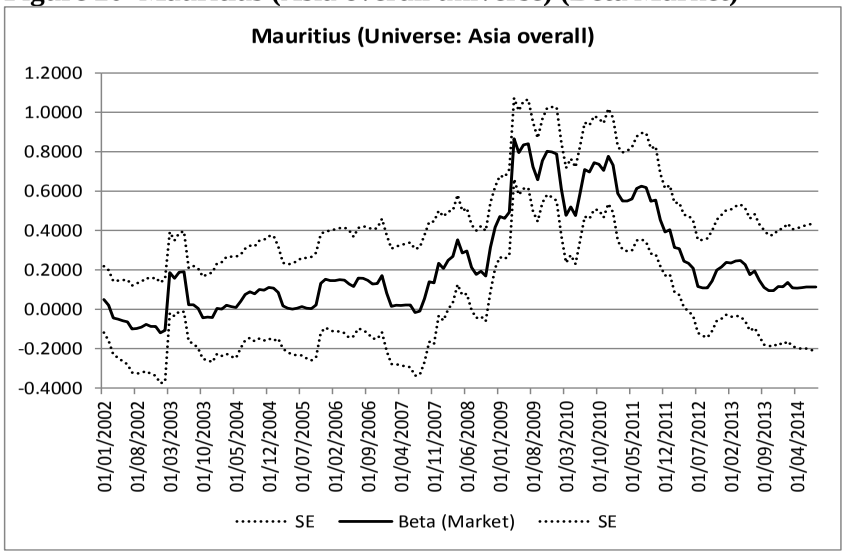

Figure 21 Mauritius (Asia overall universe) (Beta Liquidity)

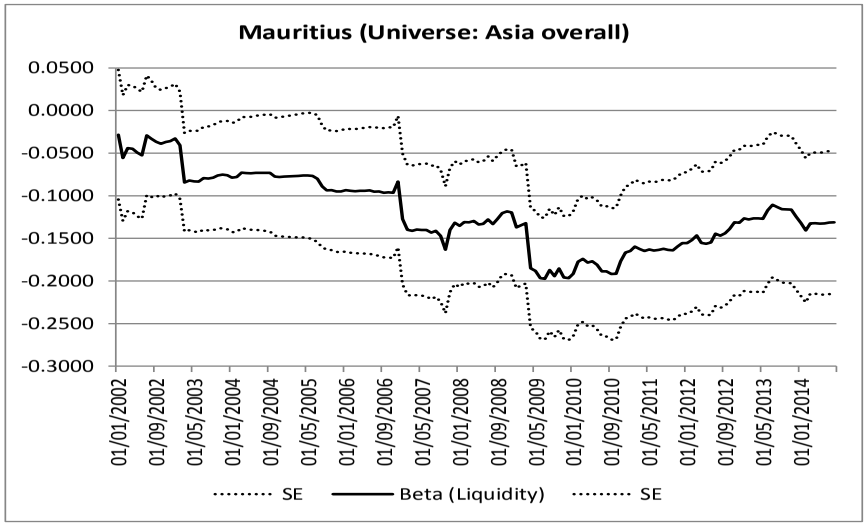

Figure 22 Japan Tokyo (Asia overall universe) (Alpha)

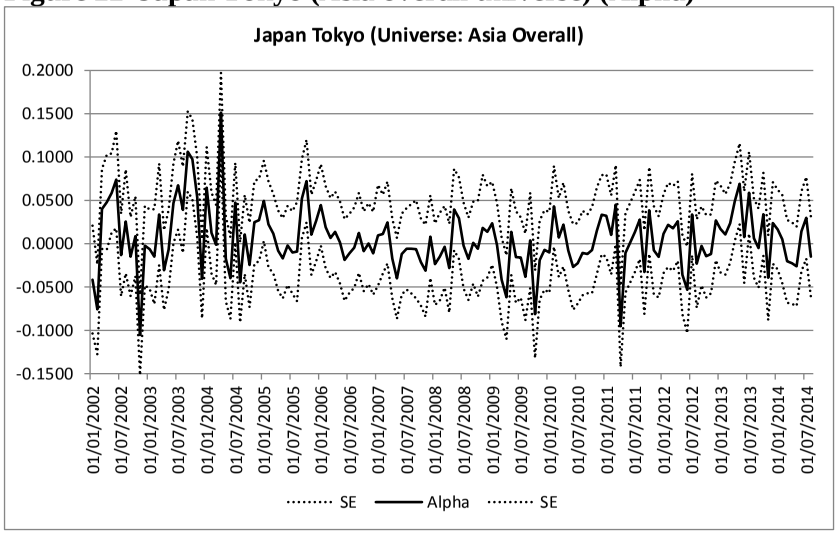

Figure 23 Japan Tokyo (Asia overall universe) (Beta Market)

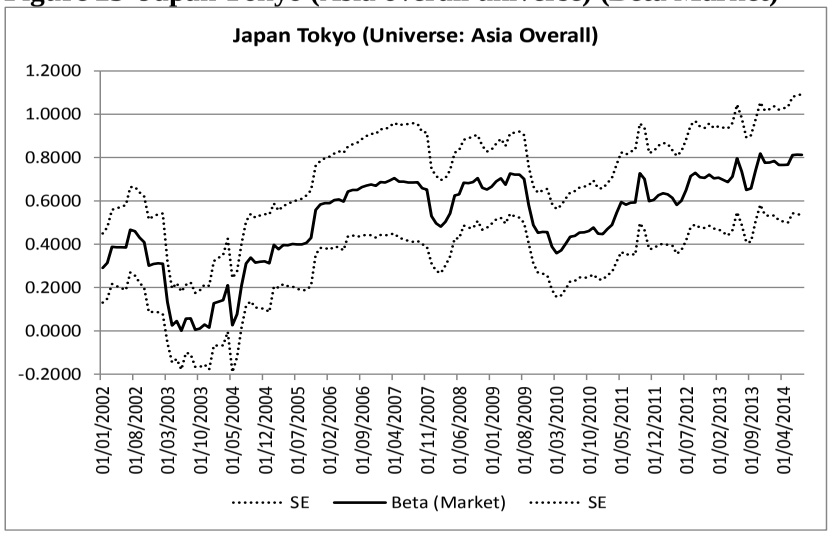

Figure 24 Japan Tokyo (Asia overall universe) (Beta Liquidity)

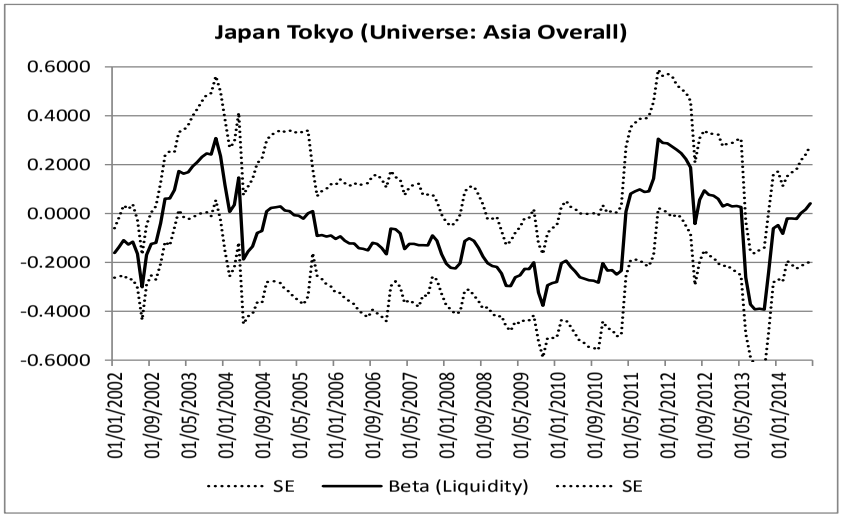

Figure 25 Japan Tokyo (Japan only universe) (Alpha)

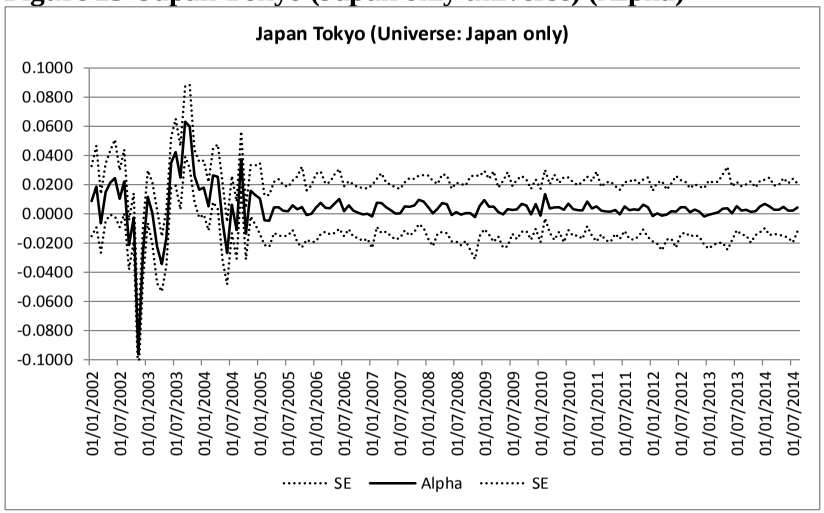

Figure 25 Japan Tokyo (Japan only universe) (Beta Market)

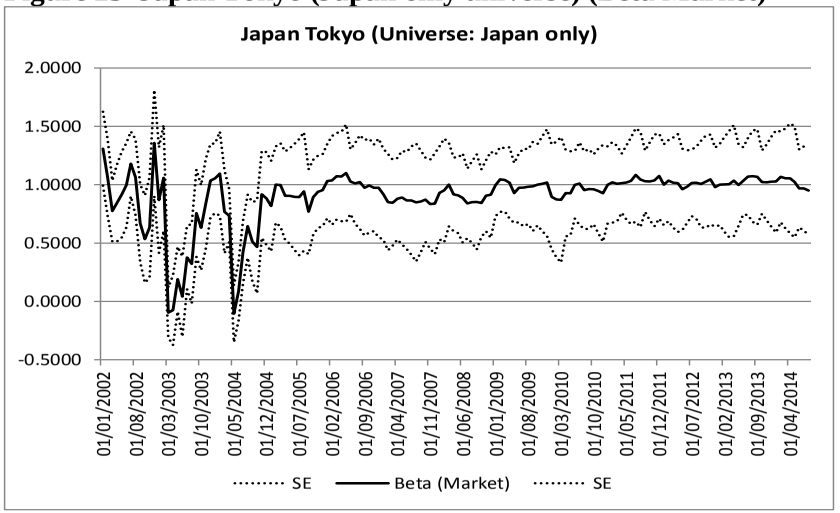

Figure 26 Japan Tokyo (Japan only universe) (Beta Liquidity)