The Extent of Convergence in Asian Real Estate Markets

By

Stephen L. Lee

Faculty of Finance
Cass Business School
City of London University
106 Bunhill Row
London
EC1Y 8TZ
England

Phone: +44 (0) 207 040 5257, Fax: +44 (0) 207 040 8880, E-mail: Stephen.Lee.1@city.ac.uk

Abstract

This paper assesses the extent to which movements in the returns of four Asia real estate markets (Australia, Japan, Hong Kong and Singapore) are each associated with movements in their neighbours' returns, within the region, in comparison with returns in the US. Using monthly data over the period 1990:1 to 2007:12 and time-varying parameter modelling techniques we find that the extent of convergence of the securitised real estate market within Asia is not a simple process, with some countries showing strong and lasting relationships while others show little or no evidence of convergence.

Keywords: *Asia Real Estate Convergence, Kalman Filter*

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Introduction

A few of studies have examined the convergence of international real estate markets and find that for some regions of the world integration is present, while for others it is not evident. For instance, Eichholtz, et al. (1998) used monthly data over the period 1984 to 1996 and a multi-factor model to examine the extent to which real estate returns are driven by continental factors. The authors concluding that a continental factor clearly exists in Europe. In contrast, Eichholtz, et al. (1998) did not find a continental factor for the Asia-Pacific region. However, in a recent study using monthly data from 1997 to 2007 Brounen and Huisman (2007) find that while some countries have become more related to the European factor others have become less dependent on the European factor, indicating that convergence maybe time-varying. A possibility confirmed in a recent study by Lee (2008).

Lee (2008) used monthly data over the period 1990 to 2007 to examine the extent of convergence of the UK real estate market with the other countries in Europe, relative to the US. The results showed that the correlations between securitised real estate market returns of the UK with both Europe and the US have not been constant over time, i.e. returns are time-varying. Then using time-varying parameter modelling techniques the results show that for some periods the UK was converging with its neighbours within Europe, while for other periods the UK was more influenced by the returns in the US. In other words, in studies testing for convergence a failure to account for the time-varying nature of returns may lead to misleading interpretations.

No study as examined the extent of convergence in Asian real estate markets using time-varying methodology techniques. Thus, we add to the convergence literature by examining the extent to which movements in the returns of four Asia real estate markets (Australia, Japan, Hong Kong and Singapore) are each associated with movements in their neighbours in the region in comparison with returns in the US utilising the Kalman Filter.

The rest of the paper is structured as follows. Section 2 presents the empirical framework for this study. Next we discuss the data in section 3. In section 4 we report and interpret the estimation results and present conclusions on the dynamic bilateral returns of the four countries used in the study relative to those in the US. Section 5 concludes the study.

Methodology

If the real estate security returns in country X are converging to those in country Y overtime then the bilateral differences in their returns should be diminishing. However, if the returns of the securitised real estate in country X are converging with those of country Z the bilateral returns of X with Y should be increasing. Therefore, Frazer et al. (1994) suggest that security market convergence can be estimated by the following equation:

$$(R_Z - R_X)_t = \alpha + \beta(R_Z - R_Y)_t + \varepsilon_t \quad (1)$$

where R_Z is the continuously compounded returns of country Z; R_X is the continuously compounded returns of country X; R_Y is the continuously compounded return of country Y; ε_t is a random error term; and α and β are the parameters of interest. So that if equation (1) was estimated using the standard OLS fixed parameter estimation, and if the country X is integrated with country Y $(R_Z - R_X)$ would be perfectly correlated with $(R_Z - R_Y)$, however, if country X was fully integrated with country Z, then $(R_Z - R_X)$ would be independent of $(R_Z - R_Y)$.

Previous research, however, has indicated that correlations between securitised markets are not constant over time. Frazer et al. (1994) therefore argue that the parameters in equation (1) should be estimated by the time-varying estimation procedure of Haldane and Hall (1991) and Hall et al. (1992), which allows for a gradual adjustment path for the temporal correlation coefficients between the pairs of bilateral spreads following the contention of Hall et al. (1992) that convergence is a process and not a state. So the profiles of α and β are allowed to evolve over time according to the following laws of motion as in equations 2a and 2b,:

$$\alpha_t = \alpha_{t-1} + \eta_t \quad (2a)$$
$$\beta_t = \beta_{t-1} + \nu_t \quad (2b)$$

where η_t and υ_t are white noise processes with variances σ_η^2 and σ_υ^2.

Thus, by reformulating the system of equations in a 'state space' form equation (1) is categorized as the measurement equation and equations 2a and 2b describe the dynamic evolution of the state parameters. Hence α_t and β_t are not constrained to having a fixed mean but allowed to vary over time according to a random walk, with the two hyperparameters σ_η^2 and σ_υ^2 determining the extent to which α_t and β_t evolve with their values estimated by the Kalman filter (see, Harvey, 1990 for more details)[1].

Using this approach Lee (2008) assessed the extent of convergence of the UK securitised real estate market with other countries in Europe relative to the US, using monthly data the period 1990 to 2007. The author finding that from 1990 the returns of the UK real estate market were more influenced by the returns of the US than those of the other countries in Europe. But from autumn 1998, short-run movements in the return of the UK securitised real estate market became increasingly associated with movements in the other countries in Europe market rather than the US. However, since 2004 the returns in

[1] The use of the Kalman filter in estimating time-varying betas in preference to the alternatives, such as GARCH models and the approach of Schwert and Seguin (1990), can be justified from previous studies in the stock market which find that while all the methodologies are successful at characterising time-varying betas the Kalman filter is more efficient (see Brookes et al., 1998 and Faff et al., 2000, among others).

the UK real estate have once again started to diverge from those of most countries in Europe.

Recently, Frazer et al. (2008) have adapted and extended the approach of Haldane and Hall (1991) and Hall et al. (1992) and recommend that time-varying convergence between countries X and Y relative to country Z should be tested by the following equations:

$$(R_Y - R_X)_t = \alpha_1 + \beta_1(R_Z - R_Y)_t + \varepsilon_{1t} \quad (3a)$$

$$\alpha_{1t} = \alpha_{1t-1} + \eta_{1t} \quad (3b)$$

$$\beta_{1t} = \beta_{1t-1} + \nu_{1t} \quad (3c)$$

$$(R_Z - R_X)_t = \alpha_2 + \beta_2(R_Z - R_Y)_t + \varepsilon_{2t} \quad (4a)$$

$$\alpha_{2t} = \alpha_{2t-1} + \eta_{2t} \quad (4b)$$

$$\beta_{2t} = \beta_{2t-1} + \nu_{2t} \quad (4c)$$

where all the variables and parameters are the same as in equations 1 and 2.

Frazer et al. (2008) pointing out that the following identity exists between the bi-lateral return spreads:

$$(R_Y - R_X) = (R_Z - R_Y) - (R_Z - R_X) \quad (5)$$

which implies that changes in the bi-lateral return spreads are associated with changes in one or other of the remaining bi-lateral return spreads in the stylized three country system. Thus an adding up constraint of the form $\beta_{2t} - \beta_{1t} = 1$ exists, which provides an opportunity to assess the robustness of the results, something which was lacking when using equation (1) to test for convergence.

Further, Frazer et al. (2008) note that the stochastic constants α_{1t} and α_{2t} partial out all the systematic influences upon the X-Y and the Z-X relationship other than those resulting from the movements in the Z-Y. Hence, the procedure will offset any potential model misspecification problems although it will not infer causal linkages, nor will it proffer any economic explanation of what determines return spreads (Haldane and Hall, 1991). Additionally, since the same systematic influences are being removed in both equations, the result that $\alpha_{1t} = \alpha_{2t}$ gives another check on robustness of the results, again not available in the original estimation procedure as specified in equation (1).

Using this approach Frazer et al. (2008) examined the linkages between the stock markets of New Zealand, Australia and various other Pacific-Basin stock markets relative to the US. Using 33 years of monthly returns the authors show find that the New Zealand stock market returns have become increasingly sensitive to fluctuations in the Australian market relative to those in other Pacific-Basin markets.

Data

In order to have consistency in terms of index calculations and composition across international countries the indices employed in this study are taken from the EPRA/NAREIT database. The EPRA/NAREIT indices ranked among the best indices for global real estate stocks in terms of coverage, investability, liquidity, float adjustment, published rules, accuracy and institutional acceptance (Frost et al., 2005) and can be viewed as representative of the real estate market of a country (Bond et al., 2003 and Yang et al., 2005).

We use monthly US dollar (USD) prices in this study, which facilitates cross-country comparability. Recent studies (e.g., Bessler and Yang, 2003) have found that international stock market linkage patterns are not substantially affected by using USD versus local currencies to measure returns. The data covering the period 1990:1 to 2007:12 for the US and four Asian countries: namely Australia, Japan, Hong Kong and Singapore. Continuously compounded returns were calculated as:

$$R_t = \ln P_t - \ln P_{t-1} \tag{6}$$

the returns therefore only comprise of the capital gain component of market returns. Nonetheless, Vassalou (2000) shows that beta estimates are insensitive to whether total or capital gains are used so the omission of dividends should not seriously affect the results. Summary statistics are presented in Table 1.

Table 1: Summary Statistics: Monthly Data 1990:1 to 2007:12

Index	Mean	SD	Skew	Kurt	J-B	Prob
Australia	0.006	0.044	-0.321	3.458	5.60	0.061
Japan	-0.000	0.094	-0.033	4.228	13.62	0.001
Hong Kong	0.009	0.100	0.068	6.391	103.64	0.000
Singapore	0.004	0.113	-0.159	6.781	129.56	0.000
US	0.006	0.042	-0.403	3.847	12.29	0.002

The summary statistics in Table 1 show that the Asian real estate market with the highest mean return over the sampled period was Hong Kong, while Japan had the lowest average return. Overall the US had the lowest risk, as measured by the standard deviation of returns, with Australia showing the lowest risk of the Asia countries and Singapore the highest risk. Four of the countries show the unattractive feature of negative skewness, with Hong Kong showing the attractive feature of positive skewness. All countries show significantly positive kurtosis (fat tails), which suggests that the returns are non-normal. Rejection of normality is also clearly indicated by the Jarque-Bera (JB) test for all countries.

Table 2 provides the contemporaneous correlations between the monthly returns of the four Asia countries and the US for the full sample period and for three six-year sub-periods (1990-1995, 1996-2001 and 2002-2007). Over the whole period the average

correlation within the Asian region is 0.342, while the average correlation between the four Asian countries and the US is 0.284. These results confirm the findings of Eichholtz, et al. (1998) that the Asia-Pacific region shows only weak evidence of a regional factor, which suggests that Asia-Pacific investors can find substantial diversification opportunities within their region. In addition, the results imply that Asia-Pacific investors should find substantial real estate diversification opportunities with America and visa versa.

Table 2: Correlation Between Australia, Japan, Hong King, Singapore and the US: 1990:1 to 2007:12 and for Three Sub-periods

1990-2007	Australia	Japan	Hong Kong	Singapore	USA
Australia	1.000				
Japan	0.240	1.000			
Hong Kong	0.350	0.141	1.000		
Singapore	0.371	0.231	0.720	1.000	
USA	0.361	0.198	0.256	0.319	1.000
1990-1995	**Australia**	**Japan**	**Hong Kong**	**Singapore**	**USA**
Australia	1.000				
Japan	0.228	1.000			
Hong Kong	0.266	-0.009	1.000		
Singapore	0.268	0.256	0.497	1.000	
USA	0.160	0.284	0.162	0.296	1.000
1996-2001	**Australia**	**Japan**	**Hong Kong**	**Singapore**	**USA**
Australia	1.000				
Japan	0.235	1.000			
Hong Kong	0.409	0.215	1.000		
Singapore	0.441	0.264	0.857	1.000	
USA	0.358	-0.065	0.308	0.358	1.000
2002-2007	**Australia**	**Japan**	**Hong Kong**	**Singapore**	**USA**
Australia	1.000				
Japan	0.245	1.000			
Hong Kong	0.322	0.256	1.000		
Singapore	0.320	0.139	0.489	1.000	
USA	0.548	0.387	0.324	0.372	1.000

The sub-period analysis in Table 2, however, shows that the degree of association between the countries has not been constant over the sample period. For instance, the correlation of Australia with the US has shown a substantial upward trend from 0.160 in sub-period 1 to 0.548 by sub-period 3. In contrast, the correlation of Australia with Hong Kong and Singapore shows an inverted U-shape, over the three sub-periods, rising from sub-period 1 to sub-period 2 then showing a decline in sub-period 3. Meanwhile, the correlation of Australia with Japan remained low in all sub-periods.

The correlation of Japan with the US showed a U-shape over the study period, initially falling from sub-period 1 to sub-period 2 only to rise again in sub-period 3. In contrast, the correlation of Japan with Singapore shows an inverted U-shape. Meanwhile, the correlation of Japan with Hong Kong shows an upward trend over the study period, rising from -0.009 in sub-period 1 to 0.256 by sub-period 3.

Finally, the correlation of Hong Kong and Singapore shows a strong but an inverted U-shape, while Singapore and Hong Kong both display a mild but rising correlation with

the US over the period of analysis. These results suggest that focusing only on the simple correlations of international securitised real estate returns, as opposed to their adjustment path can be misleading.

Results

Recall we are using equations (3) and (4) to test whether the securitised real estate market returns in each country in Asia is converging with its neighbours within the region relative to the US. The parameters β_{1t} and β_{2t} indicating the extent of convergence.

Frazer et al. (2008) point out that the parameters β_{1t} and β_{2t} are only relative and not absolute measures of convergence. So for instance, from the above framework one might assume that if $\beta_{2t} \approx 0.5$ would signify that Asian country X is independent of its neighbouring country Y and responds only to domestic factors. However, the correct interpretation of this scenario is that Asian country X is no more or no less converged with its neighbouring country Y, relative to the US. On the other hand, the closer that β_{1t} is to 0, or β_{2t} is to 1, the greater the confidence we can have that the Asian country under consideration is converging with its neighbour, while the closer that β_{1t} is to 1, or β_{2t} is to 0, the greater the confidence we can have that the Asian country under scrutiny is not converging with its neighbour.

The results for the Kalman filter values β_{2t} are shown in Table 3 and Figures 1 to 4, since the β_{1t} values give essentially the same information but the β_{2t} values are easier to interpret, i.e. if Australia is converging with one of its' neighbours within the region $\beta_{2t} \rightarrow 1$, however, if Australia is not converging with its neighbour $\beta_{2t} \rightarrow 0$.

In the analysis the adding-up constraint $\beta_{2t} - \beta_{1t} = 1$ is satisfied by the data, with deviations typically less than 0.0001. Moreover, the constraint $\alpha_{1t} = \alpha_{2t}$ is also satisfied. Thus the estimation procedure would appear to be robust to the weighting between the state equations.

Table 3: Summary Statistics of the Kalman Filter Coefficients

Australia/US relative to	Japan	Hong Kong	Singapore
Mean	0.16	0.15	0.19
Standard Deviation	0.08	0.21	0.09
Japan/US relative to	**Australia**	**Hong Kong**	**Singapore**
Mean	0.64	0.15	0.22
Standard Deviation	0.22	0.28	0.32
Hong Kong/US relative to	**Australia**	**Japan**	**Singapore**
Mean	0.50	0.10	0.55
Standard Deviation	0.34	0.22	0.18
Singapore/US relative to	**Australia**	**Japan**	**Hong Kong**
Mean	0.62	0.15	0.61
Standard Deviation	0.25	0.22	0.33

Table 3 shows a number of features of interest. First, the average time-varying beta coefficients for Australia with Japan, Hong Kong and Singapore are all less than 0.2,

which suggests that returns in Australia are not affected by those of the other three neighbouring countries in the region and are more influenced by the perturbations in the US real estate market. Second, the returns of the securitised real estate market in Japan are substantially influenced by those in Australia, but are unaffected by those in Hong Kong and Singapore. Third, the returns in the Hong Kong appear to be influenced by both the returns in Australia and Singapore but unaffected by returns in Japan. Finally, Table 3 shows that returns in Singapore are not influenced by movements Japan but are influenced by Australian and Hong Kong returns.

The standard deviation values in Table 3 show that for some counties the average Kalman filter coefficients are subject to considerable variation over time. For instance, the standard deviation values for Japan with Australia, Hong Kong and Singapore indicate these relationship is unstable over time, whereas the other three country relationships show little variation overtime. This is more easily seen in Figures 1 to 4[2].

As can be readily seen in Figure 1 Australia shows little evidence of convergence with its neighbours, confirming the results in Table 3. The Kalman filter values typically never going above 0.5 and show little or no trend until the middle of 2003 after which there has been a slight upward trend with Hong Kong and Singapore.

If we now consider Figure 2 we see that Japan has had a strong and continuous relationship with Australia, but no relationship with Hong Kong or Singapore. Indeed, in a number of years (1994 to 1996 and 2001 to 2003) Japan's relationship with Hong Kong and Singapore has been negative, which implies that the returns in Japan relative to both these countries were indicating a 'market bubble', which took some time to correct.

The results in Figure 3 show that Hong Kong is strongly influenced by Australia and Singapore, whereas Hong Kong as little in common with Japan. Figure 3 also confirms the findings in Figure 2 that Japan was showing a 'market bubble' in 1994 to 1996 and 2001 to 2003.

Finally, Figure 4 shows that Singapore displays a comparatively stable and mild relationship with Hong Kong. But that Singapore has had a volatile relationship with Australia, rising from 04 to exceed unity in 97 to 99, indicative of a market bubble, after which Singapore's relationship with Australia declined to stabilise at about 0.6. Finally, Figure 4 shows that Singapore's relationship Japan has been generally weak, apart from 1997 to 1998.

Conclusion

The aim of this paper is to consider the short-run bilateral linkages between the securitised real estate market of four countries in Asia (Australia, Japan, Hong Kong and Singapore) and the US. Using monthly data over the period 1990:1 to 2007:12 our results can be simply stated. First, the correlations between the four securitised real estate

[2] Since the Kalman filtering procedure takes sometime to settle down the values in Figure 1 to 4 start in 1991 rather than 1990.

markets in Asia have not been constant over time, i.e. returns are time-varying. Second, using time-varying parameter modelling techniques we find that the extent of convergence of the securitised real estate market within Asia is not a simple process, with some countries showing strong and lasting relationships while others show little or no evidence of convergence.

In addition, the results suggest that the relationships are uni-direction for some countries but bi-directional for others. For instance, the returns in Australia show little association with the returns of its neighbours, whereas the returns in Japan and Hong Kong are strongly linked with Australia. In contrast, the Singapore and Hong Kong markets show strong links with each other.

Taken together these results confirm the findings of Eichholtz, et al. (1998) that the Asia-Pacific region shows only weak evidence of a regional or continental factor, which suggests that Asia-Pacific investors can find diversification opportunities both within and outside their region. In addition, the results imply that North American investors should find real estate diversification opportunities in the Asia-Pacific region.

References

Bessler, D.A. and Yang, J. (2003) The Structure of Interdependence in International Stock Markets, *Journal of International Money and Finance*, **22**, 261–87.

Bond, S.A., Karolyi, G.A. and Sanders, A.B. (2003) International Real Estate Returns: A Multifactor, Multicountry Approach, *Real Estate Economics,* **31**, 481-500.

Brookes, R.D., Faff, R.W. and McKenzie, M.D. (1998) Time-Varying Beta Risk of Australian Industry Portfolios: A Comparison of Modelling Techniques, *Australian Journal of Management*, **23**, 1-22.

Brounen, D. and Huisman, R. (2007) *Continental Factors Revisited: Evidence from International Property Shares*, A paper presented at the European Real Estate Society Meeting London, June.

Eichholtz, P.M.A., Huisman, R. Koedijk, K. and Schuin, L. (1998) Continental Factors in International Real Estate Returns, *Real Estate Economics,* **26**, 493-509.

Faff, R.W., Hillier, D. and Hillier, J. (2000) Time-Varying Beta Risk: An Analysis of Alternative Modelling Techniques, *Journal of Business Finance and Accounting*, **27**, 523-555.

Frazer, P., Helliar, C.V. and Power, D.M. (1994) An Empirical Investigation of Convergence among European Equity Markets, *Applied Financial Economics*, **4**, 149-157.

Fraser, P. McAlevey, L. and Tayler, M. (2008) The New Zealand Markets Relationship with Australia and Pacific-Basin Share Markets: is New Zealand Converging with Australia?, *Applied Financial Economics*, **18**, 6, 451-462

Frost, C., Schioldager, A. and Hammond, S. (2005) Real Estate Investing the REIT Way, *Investment Insights*, Barclays Global Investors, **8**, 7.

Haldane, A.G. and Hall, S.G. (1991) Sterling's Relationship with the Dollar and the Deutschemark: 1976-89, *The Economic Journal*, **101**, 436-443.

Hall, S.G., Robertson, D. and Wickens, M.R. (1992) Measuring Convergence of the EC Economies, *The Manchester School*, **60**, 99-111.

Harvey, A. (1990) *The Econometric Analysis of Time Series*, Philip Allan, Hemel Hempstead.

Lee, S.L. (2008) *Is the UK Real Estate Market Converging with the Rest of Europe*?, a paper presented at the European Real Estate Society Meeting, Krakow, Poland, June

Schwert, W. and Seguin, P. (1990) Heteroskedasity in Stock Returns, *Journal of Finance*, **45**, 1129-1155.

Vassalou, M. (2000) Exchange Rate and Foreign Inflation Risk Premiums in Global Equity Returns, *Journal of International Money and Finance*, **19**, 433-470

Yang, J., Kolari, J.W. and Zhu, G. (2005) European Public Real Estate Market Integration, *Applied Financial Economics*, **15**, 13, 895-905.

Figure 1: Time-Varying Beta Coefficients: Australia with Japan, Hong Kong and Singapore

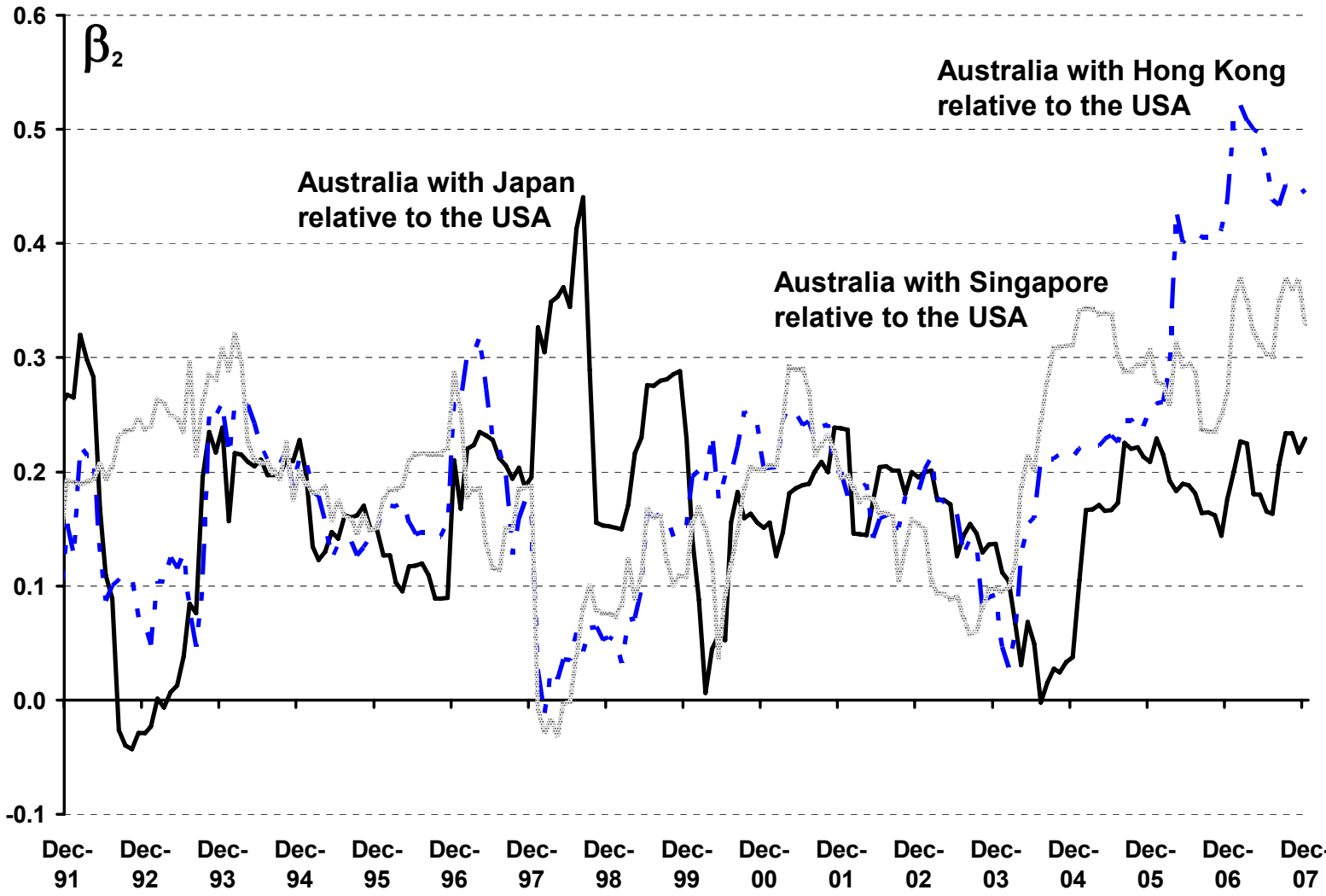

Figure 2: Time-Varying Beta Coefficients: Japan with Australia, Hong Kong and Singapore

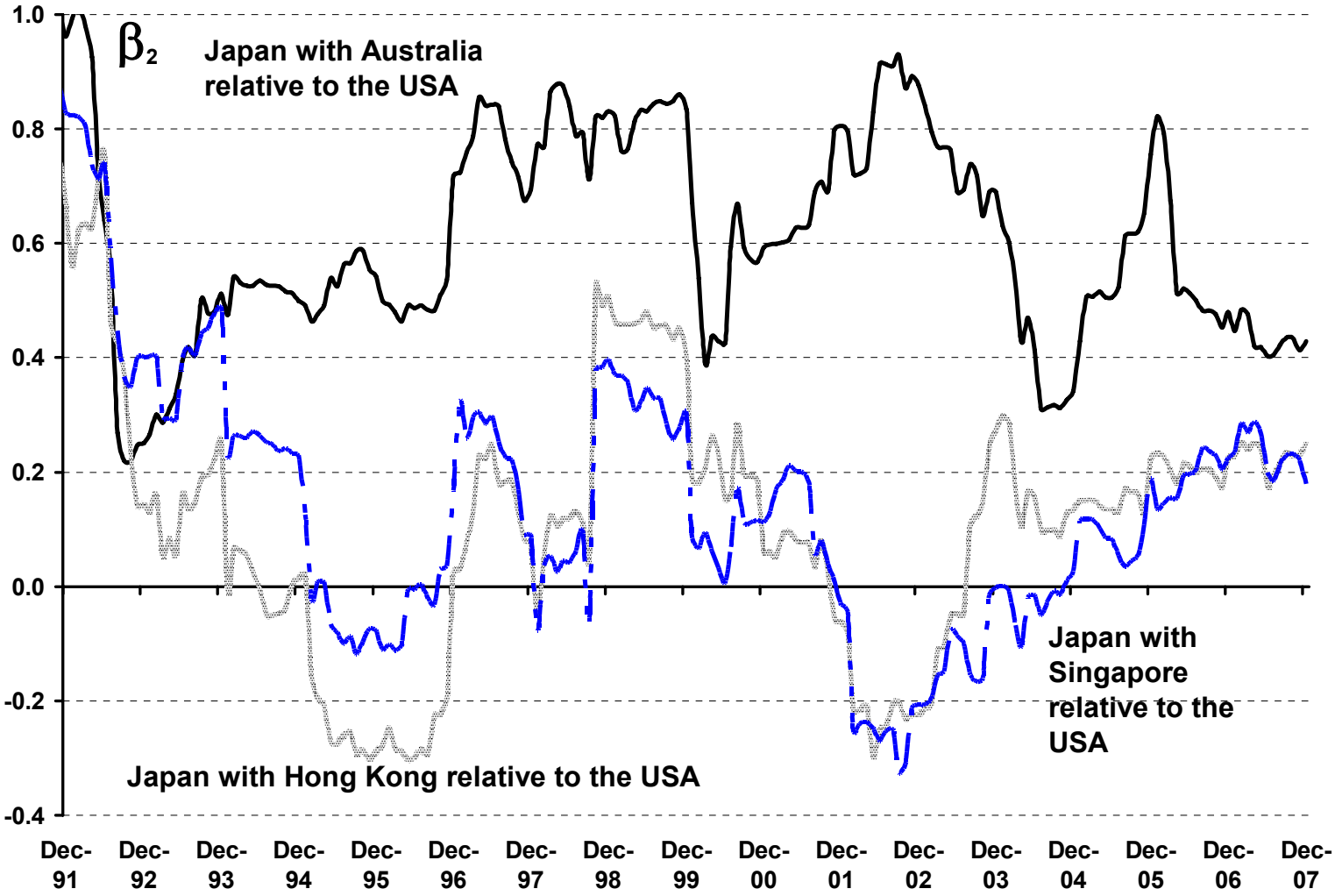

Figure 3: Time-Varying Beta Coefficients: Hong Kong with Australia, Japan and Singapore

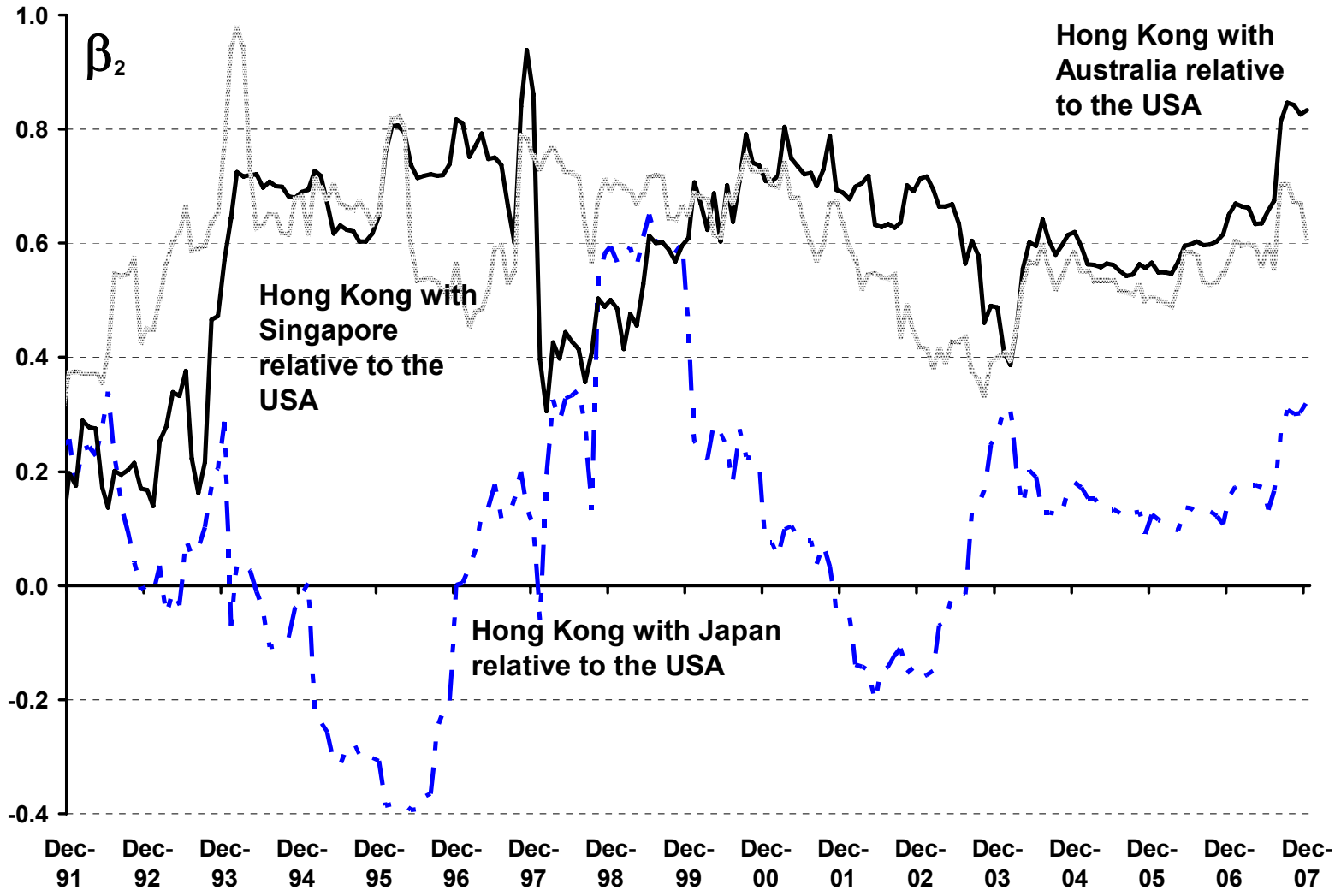

Figure 4: Time-Varying Beta Coefficients: Singapore with Australia, Japan and Hong Kong