CHAPTER IV

TESTS OF MARKET INTEGRATION

A. Latent-Variable Tests of Market Integration

In this study, I follow a test of international capital market integration proposed by Khanthavit and Sungkaew (1993). In addition, I use specific procedures to acquire the appropriate data set in order to test the international capital market integration. The idea is motivated by the concept of Errunza and Losq (1985) that a subset of investors do not invest in a certain set of assets due to some constraints. Compared with the traditional latent-variable method, this approach provides a test of zero-investment barriers (implying market integration) in addition to the specification test of the model. Compared with the model investment barriers of Black (1974) and Stulz (1981) which employ specific capital and pricing models, this test reduces the chance of picking the wrong benchmark portfolios. In addition, this study reduces the possibility of false rejection due to segmentation within the market, compared with other studies which employ index returns across markets to test international market integration.

This study applies the concept of *mild segmentation* together with the model of Stulz (1981). My study assumes a market structure such that investors will have unequal access to markets; the local market is segmented since domestic investors of a country (Thailand) hold only their domestic securities, whereas other investors (foreigners) hold some domestic (Thai) securities and their home securities. Therefore, Thai stocks are divided into two classes: eligible and ineligible, where ineligible equities are Thai stocks that are not held by foreign investors. However, the method by which an asset is considered eligible (ineligible) does not come from any specific restriction in our model. The characterization of the eligible (ineligible) segments relies mainly on

perceived barriers in which assets can be considered ineligible if they are not active owned by foreign investors. Therefore, I propose that investors choose do not invest in certain assets not because of their inability, but because of their preference[4].

In addition, foreign equities are considered as eligible assets with respect to foreign investors. In order to test the international capital market integration, the Thai eligible assets should be used to test against foreign equities. The reason is that the required return on an eligible security suggested by a mean-variant asset pricing model is not affected by this market setting whereas the required return on an ineligible asset would be different from what is suggested in the model because of the diversification effect. Consequently, the use of an inappropriate data set such as an ineligible asset or an aggregate national index can bias the tests of international market integration. For example, the results of using ineligible assets in the test for international investment barriers should indicate larger investment barriers compared to tests that use eligible assets to test since the extra measurement of barriers may be due to substantially higher risk premiums that would generally be commanded by the ineligible securities.

B. Identifying Eligible and Ineligible Assets

The procedures to identify eligible assets and ineligible assets are also an interesting issue. Initially, researchers investigated the characteristics of the assets preferred by foreign investors. As an example, Kang and Stulz (1994) document that foreign investment holdings in Japan are biased towards large firms among other variables because of information asymmetries. In this study, the specific characteristics of equities preferred by foreign investors will be investigated. Since the actual foreign

---

[4] *Similarly, Merton (1987) models an economy in which each investor trades only the subset of available risky assets with which he or she is familiar.*

portfolio holdings cannot be assessed, the sample data used to discriminate the characteristics of the eligible and ineligible assets are drawn from stocks acquired by mutual funds.[5] Sampling from mutual fund holdings will give the set of equities that are selected by mutual funds. Mutual funds generally invest in a subset of the market and are biased toward only certain equities. These characteristics should be the same as the characteristics of stocks selected by foreign investors who normally invest through funds. The intuition is that mutual funds and foreign investment are institutions; they should have some criteria to select the stocks for their portfolios since institutional investors typically have their own investment objectives or style.

1. The Data

The portfolio holdings of Thai mutual funds are from the Stock Exchange of Thailand during 1993-1995. In order to construct Thai eligible returns, I will create them from stocks traded by Thai mutual fund portfolios and adjust semi-annually; returns are reported monthly. Returns on investors' home country equity portfolios as measured in local currencies are available from Morgan Stanley's Capital International Perspective (MSCI). The Thai returns measured in US dollars are also from MSCI and converted to returns measured in the currencies of the investor countries using the end-of-the month exchange rates from Datastream International of the Dun and Bradstreet Corporation. The risk free rates for Hong Kong, Singapore, and Japan are

[5] *The assumption is that the characteristics of stocks preferred by mutual funds will also be preferred by foreign investors because they are both institutional investors. Therefore, the criteria used to segregate securities are the stock characteristics revealed by mutual fund holdings. Falkenstein (1995) shows that mutual funds have a significant preference towards firms with high visibility and low transaction costs, and are averse to stocks with low idiosyncratic volatility.*

the one month call deposit rates; the rates for the UK are from the London Clearing Banks rates; and the rate for the US are the one-month Treasury bill rates. The Thai rate is the one month interbank rate. Finally, the instrumental variables are all available from Datastream International of the Dun and Bradstreet Corporation.

2. Determining Eligible Assets -- Selecting Samples from Mutual Funds

In order to test international investment barriers, I need to construct the group of stocks preferred by foreign investors[6]. Without observed foreign portfolios, it is hard to classify the eligible stocks chosen for investment by both foreign and domestic investors. However, this problem can be overcome if I make an extra assumption about the behavior of foreign investors: their investment patterns are the same as mutual fund patterns. The reason behind this assumption is that foreign investors are viewed as institutional investors.[7]

I refer to the stocks chosen by mutual funds as *eligible assets*, since these stocks are chosen as investments by both mutual funds and individual investors whereas the ineligible stocks are not chosen by mutual funds. Mutual funds typically have specific investment objectives or a "style". I propose the determination of mutual fund style by simply investigating the portfolio holdings of mutual funds to classify

---

[6] *I applied this calculation based on the study of Falkenstein (1997). He uses this formula to investigate the preference for stock characteristics revealed by a cross-section of mutual funds in the US for the years 1991 and 1992.*

[7] *Evidence typically supports that fact that institutional investors are attracted to large and less risky stocks. However, there are still some studies showing that institutional investors are associated with riskier securities; for example, Sias (1996).*

stocks into two groups: selected by mutual funds and not selected by mutual funds. To examine this issue, the results are based on cross-sectional time series.

Since data are not available for mutual fund portfolio holdings in the period of 1988-1992, I apply the logit analysis to estimate the stocks that should be selected by mutual funds during that period. Before applying the logit analysis, I check the accuracy of the estimation. In order to use the estimation for prediction, I also have to check the accuracy for out-of-sample. I address this concern by conducting an out-of-sample analysis based on the following steps:

1) Analyze data between 1993 and 1994 using the logit procedure
2) Make a 'one-step-ahead' forecast of the likelihood of stocks that fall into the criteria to be selected by mutual funds for 1995.
3) Compare the group of stocks selected by forecasting to the group which mutual funds actually selected.
4) Judge the accuracy of the model and determine if the logit equations are applicable for selecting the stocks in the period of 1988 through 1992 as though the stocks had been selected by mutual funds.

a) Model variables

$$OWN_i = \sum_{s=1}^{M} \frac{\text{shares of stock } i \text{ owned by fund } m \text{ at time } t}{\text{number of shares outstanding of stock } i \text{ at time } t}$$

The variables are:

Size - market capitalization scaled by the total market capitalization of the market;
Age - number of months the security has been listed;
Price level - the price-earnings ratio;

Volatility of return - degree of fluctuation in share price during the previous 12 months based on the last 52 weekly values[8].

Beta - the slope from a regression of stock return against market return calculated over the last 5 years;

EPS - earnings per share; and

DY - dividend yield.

The relevance of these variables is important and merits a discussion. I include a measure of size (market capitalization) in the analysis since this measure may form a limitation for investing in the individual securities for the mutual fund. Size can constraint fund demand for small capital stocks. A similar argument can be found in Sias (1996). Moreover, Arbel, Carvell, and Strebel (1983) also point out that institutional investors avoid small-capitalization stocks since a large holding in a small-capitalization security may force managerial participation.

The 'age' variable is used as a proxy for information. Firms that have been listed in the market for short time might not have enough information available to estimate their risk. French and Poterba (1991) offer a similar explanation. They note that the small proportion of foreign investments in typical American and Japanese stock portfolios and speculate that investors avoid assets about regarding which they have limited information and experience. Therefore, it is reasonable to expect that foreign investors will prefer large, well-known Thai equities which are easier for foreign investors to acquire information. I include the price-earnings ratio as an independent variable because it can be regarded as a way to scale stock prices to extract information about risk and expected return as suggested by Fama and French (1992).

---

[8] *Volatility of return is calculated using the standard deviation of the price divided by the mean price and multiplied by 40 to give a figure scaled from 1 to 20.*

Next, the volatility and beta of stocks are used as explanatory variables in the analysis. The high volatility of returns of equities or stocks that have a beta of more or less than 1 is usually considered as evidence of high risk. The relationship between security return volatility and level of institutional ownership has received much attention by academics. The debate whether riskier securities or lower risk securities would attract institutional investors has generated a lot of interest. Badrinath, Gay, and Kale (1989) among the others argue that institutional investors are likely to choose less-volatile stocks because of the risk that investments in more-volatile securities may not be viewed as *prudent*. Other variables of interest include earnings per share and dividend yield. These two variables reflect the other sources of payoff rather than the gain from selling the securities. This point is suggested by Ball (1978). He argues that earnings-price ratio is a catch-all proxy for unnamed factors in expected return. Basu (1983) shows that earnings-price ratios help explain the cross-section of average returns. Mutual funds are usually viewed as long term investors hence these payoff characteristics should be important for them to highlight desirable securities to hold in a portfolio.

b) Methodology for Constructing Eligible Assets

Step 1 -- Select mutual funds

Include only those mutual funds that hold more than 50% of their portfolios in equities.

Step 2 -- Calculate ownership percentages

Find the monthly percentage of shares owned by mutual funds for each stock listed in the SET over a 2 year period (ownership proportion).

Step 3 -- Collect characteristics

Capture the important characteristics of all stocks selected. These characteristics (described above) will be the independent variables.

Step 4 -- Logit regression

Run a logit analysis regression where the dependent variable is equal one if the percentage of a stock owned by a mutual fund is positive otherwise the dependent variable is equal zero. Its characteristics are the independent variables in the analysis.

Step 5 -- Separate stocks

The regression outcomes will be the criteria used to separate Stock Exchange of Thailand (SET) listed stocks into eligible (preferred by mutual funds) and ineligible (not preferred by mutual funds) categories for the period 1988-1992 and 1993-1995. The sample is divided in this fashion to acknowledge changes in policy and the presence of more foreign investment.

3. Results -- Eligible Assets Determined

Table 4-1 reports the characteristics of stock during 1993-1995. The beta of stocks chosen by mutual funds is higher on average than the beta of stocks not chosen. The market capitalization of the stocks for both sets are not similar. Market capitalization is about 1 percent of the total market capitalization for stocks selected by mutual funds whereas it is about 0.1 percent for stocks not selected by mutual funds. From the findings, mutual funds selected stocks that have lower PE and EPS but had been listed on the exchange for a longer time. Volatility is also higher in the

group of stocks selected by mutual funds. However, the dividend yield in these two group is not significantly different.

The results shown in of Table 4-1 mostly are as we expect. It indicates that volatility, size, price to earnings ratio, earnings per share, age, and volatility are all significant in explaining aggregate mutual fund holdings of individual securities. In our study, mutual funds are averse to low beta stocks which is one of the measurement of risk. We also see that the preferences of mutual fund are biased towards volatile stocks. The aversion to low risk stocks is inconsistent with our hypothesis that institutional investors should be attracted to less-risky stocks. However, the results are not surprising; they can be explained by many reasons. It may be due to the mutual fund management strategy. Typically, most funds actively manage their portfolios and are able to identify undervalued stocks. Thus, if one has the ability to spot undervalued stocks, one might choose the stocks that outperform the market by a significant amount rather than stocks that offer a modest performance. As another explanation, Sias (1996) argues that an increase in institutional investor interest may result in an increase in volatility. The size preference of mutual funds indicates that mutual funds, as expected, prefer securities with large capitalization. Similar results have been shown in many previous papers.[9] The explanation comes from the issue of information since it is typical that information from larger firms is more easily obtained than information about small capital firms. With the variable age as a proxy for aggregate information, the bias toward older stocks is expected because older stocks have a more established reputation and thus less estimation uncertainty of the riskiness. Falkenstein (1995) offers a similar result that mutual funds have a significant preference towards firms with longer period

[9] *See, for example, Arbel, Carvell, and Strebel (1983).*

of listing. The results also show the influence of P/E and EPS on mutual fund preferences. The mutual fund preference of low P/E is as we expected, however, the preference toward low EPS is unexpected. We expect that mutual funds should invest in stocks that have high EPS since this factor can be a proxy for the return of long term investment. One possible explanation is to consider stocks with lower P/E and EPS as growth stocks, hence trend following may bias mutual funds towards this type of stock.

Table 4-1: Descriptive Statistics of Characteristics of Stocks during 1993-1995*

Characteristics of Stock	Selected by Mutual Funds		Not Selected by Mutual Funds	
	Mean	Std. Dev.	Mean	Std. Dev.
Beta	0.75	0.33	0.53	0.24
MV	0.01	0.01	0.001	0.001
PE	32.02	119.91	39.99	201.05
Period	1692.41	848.30	1525.47	763.61
Vol	6.48	2.54	6.26	2.89
EPS	6.51	8.25	3.64	4.62
DY	3.53	3.51	4.05	3.80

* **Note** : the above number are the average of the pooled data and over time

Table 4-2 provides the results of the check for estimation accuracy. The estimation accuracy for the sample (1993-1994) is about 72.50%. The accuracy of the out-of-sample is about 70.60%, wrong prediction is less than 50%, hence the model is judged accurate. Therefore, the logit equations are applicable for selecting the stocks in the period of 1988 through 1992 as though the stocks had been selected by mutual funds.

Table 4-2: Contingency Tables

Forecasting mutual fund holdings (in the sample) during 1993-1994
using Logit equation from 1993-1994

	Actual	
Forecast	Hold	Not Hold
Hold	35.40%	21.30%
Not Hold	6.20%	37.10%

Forecasting mutual fund holding (out of sample) during 1995
using Logit equation from 1993-1994

	Actual	
Forecast	Hold	Not Hold
Hold	30.40%	22.60%
Not Hold	6.80%	40.20%

From Table 4-3, the coefficient of size, age, earnings per share and dividend yield are significantly different from zero. As a result, multivariate logit analysis is performed using these variables as independent variables as presented Table 4-4. Within the framework of maximum likelihood estimation, the hypothesis whether the coefficients are jointly zero is rejected with chi-square equal to 30.19.

Table 4-3: Significance Tests for Individual Variables

Logit Analysis where stock owned by mutual fund during 1993-1995 is dependent variable against its characteristics as independent variable.

Variable	Coefficient	T-Stat
Beta	0.755	0.386
MV	510.905	11.998*
PE	2.422 E-05	0.095
Period	0.002	2.706*
Vol	-0.048	-2.627
EPS	0.073	8.445*
DY	-0.033	-2.479*

Table 4-4: Logit Analysis

Logit $OWN_i = \beta\xi_t$ Where OWN_i = 1 if selected by mutual fund
0 if not selected by mutual fund

and ξ_t consists of:

Size - market capitalization scaled by the total market capitalization of the market (MV);
DY - dividend yield;
Age - number of months the security has been listed (periods);
EPS - earnings per share.

Var	Cof	T-stat
C	-0.680	-5.490
MV	509.840	11.290
DY	0.005	0.360
Period	1.84 E-05	0.304
EPS	0.050	5.645
	$\chi^2 = 30.19$	Prob 0.0000

From the test described above, we can determine the group of stocks preferred by foreign investors and begin the tests for international investment barriers.

C. Testing for Market Integration

1. Theoretical Framework -- Single Latent-Variable with Investment Barriers

In order to test for market integration, I assume that assets are priced with the single factor capital asset pricing model. I then apply the model that incorporates the investment barriers as a cost of extra-national investment as developed and enhanced by Black (1974), Stulz (1981), and Wheatley (1988). The model is:

$$E\left[(R_{it} - \tau_{it}) - R_{ft} \mid \Omega_{t-1}\right] = \beta_{it} E\left[(R_{pt} - \tau_{pt}) - R_{ft} \mid \Omega_{t-1}\right]$$

where :

$E[\ldots\ldots \mid \Omega_{t-1}]$ = expectation operator conditioned on Ω_{t-1}, the information at time *t-1*;

R_{it} = real excess return on asset *i* at time *t*;

R_{pt} = real excess return on the benchmark portfolio *p* at time *t*;

R_{ft} = return on a risk free asset;

β_{it} = $COV_{t-1}(R_{it}, R_{pt}) / Var_{t-1}(R_{pt})$.

In the model, τ_{it} are the investment barriers corresponding to asset *i* at time *t*. Since τ_{it} are the investment barriers that investors face when investing aboard, τ_{it} would be zero if *i* is an asset that is local to the investors. The variable τ_{pt} is a distortion induced by investment barriers; it is a weighted average τ_{it} in equilibrium. This model implies complete market integration if there exists zero investment barriers. R_{it} is the gross return on asset *i* before investment barriers. From our point of view, the asset *i* must be the asset considered as an eligible asset by investors since only the gross return of an eligible asset is the riskless return plus the market's risk premium times the risk which is priced in the market. In contrast, the gross return of an ineligible asset with the same price of risk demands a higher return to compensate for much higher risk premium. Therefore, if we use an ineligible asset as asset *i* in the

above model, the investment barriers measured from the model should lead to unambiguous results because they decide the much higher risk premium into the measured investment barriers.

The portfolio *p* can be identified as being the world market portfolio as in Solnik (1974) or world consumption as in the consumption capital asset pricing model of Breeden (1979). However, these models will give the problem of unobservable portfolios as described in Roll's critique (1977) or will also introduce errors in measurement of consumption data (Wheatley (1988)). I then apply the single latent-variable with investment barriers model which substitutes the return on the unobserved benchmark portfolio so that the benchmark return does not need to be estimated[10]. The theoretical model is as follows:

$$E\,[R_{it}-R_{ft}\,|\,\Omega_{t-1}\,] = \beta_i E\,[(Rp_t - R_{ft}) - \tau_{pt}\,|\,\Omega_{t-1}] \quad (1)$$

$$E\,[(R_{jt}-R_{ft}) - \tau_j\,|\,\Omega_{t-1}\,] = \beta_j E\,[(Rp_t - R_{ft}) - \tau_{pt}\,|\,\Omega_{t-1}\,] \quad (2)$$

$$E\,[(R_{jt}-R_{ft}) - \tau_j\,|\,\Omega_{t-1}\,] = \beta_j/\beta_i E\,[(R_{it}-R_{ft})\,|\,\Omega_{t-1}\,]\,] \quad (3)$$

$$E\,[(R_{jt}-R_{ft}) - \tau_j\,|\,\Omega_{t-1}\,] = \beta^*_j E\,[R_{it}-R_{ft}\,|\,\Omega_{t-1}\,] \quad (4)$$

In Equation (1), I did not denote τ_{it} in the model since I consider asset *i* as a local asset to the investor. In my study, let *i* be a stock domestic to the investor and *j* be a Thai stock. Substituting R_{it} and R_{jt} for R_{pt} can reduce estimation problems substantially. It should be noted that the model allows β_i and β_j to be time varying but

---

[10] *There are many studies which suggest how to specify an observable benchmark, since the hypothesis supporting integration may be rejected merely because an inappropriate benchmark portfolio was specified. To avoid this problem, this study will use an alternative model built around unobservable benchmarks. The method of single latent-variable states that expected returns on all assets vary through time in a perfectly correlated fashion, because they are all being driven by the changing price of a single unobserved source of risk.*

the movements are proportional so that β^*_j is constant. Although τ_j are also allowed to be time varying, I will assume that τ_j is orthogonal to the information set such that τ_j is interpreted as average investment barriers.[11] To estimate equation (4), I have to follow Cumby (1989, 1990) to use a linear projection of the expectations at time *t* onto an instrumental set of information at time *t-1*.

This assumption can be shown as follows:

$$E\left[(R_{kt} - R_{ft}) \mid \Omega_{t-1}\right] = Z_{t-1}\alpha_k + e_{kt} \qquad (5)$$

where α_k is an (M * 1) vector of projection coefficients and e_{kt} is the projection error

By this construction, the projection error is orthogonal to the instrumental vector. The second assumption that should hold to estimate equation (4) is the assumption of rational expectations. The rational expectation is that agents use all information to form their expectations. By this second assumption,

$$R_{kt} - R_{ft} = E\left[R_{kt} - R_{ft} \mid \Omega_{t-1}\right] + w_{kt} \qquad (6)$$

These two assumptions combined with the model in equation (4) give a statistical model:

$$R_{it} - R_{ft} = \alpha'_i Z_{t-1} + U_{it} \qquad (7.1)$$

$$R_{jt} - R_{ft} = \beta^*_j Z_{t-1}\alpha_i + \tau_j + U_{jt} \qquad (7.2)$$

Hence, U_{kt} must be orthogonal to Z_{t-1} since it is a linear combination of e_{kt} and w_{kt} which both are orthogonal to Z_{t-1} as described above. In testing equation system

---

[11] *Constraining τ_j to be constant while the fact it is time varying may lead to a false rejection of the model or a test with low power.*

(7), the variable τ_j can be positive or negative, but unlike in Black (1974), a negative τ_j is interpreted as an investment barrier imposed on a short position.[12]

These cross-equation restrictions can be tested using Hansen's (1982) generalized method of moments (GMM). This method is built on the orthogonality of the regression residuals with the instrumental variables. Therefore, it is appropriate to directly apply GMM for the tests of equation system (7) that the orthogonality condition imposed on disturbances and instruments is a necessary condition. An algorithm searches for parameter values that minimize the quadratic form of the orthogonality conditions, serving as a goodness-of-fit statistic for the model. It is asymptotically Chi-square distributed with a degree of freedom equal to the number of over-identifying restrictions calculated as MN-P, where M is the number of columns of Z_{t-1}, N is the number of test assets, and P is the numbers of parameters in the system. Thus, the degree of freedom in testing equation 7 in this study is 3. If the model is not rejected, the regression errors must be orthogonal to the instrumental variable (Z_{t-1}). Its rejection is also important to the study since the criterion function can be used to check the proportionality restriction implied by the model. In addition, Z_{t-1} in the model is a subset of information used to explain the return. Z_{t-1} may be formed from various combinations of the elements of Ω_{t-1} and may be specific to the test asset. Different combinations give different sample variance of U_{kt}, but the combination that best explains the return will give the smallest sample variance.

Another reason why the GMM is appropriate to my study is the implication of the orthogonality of deviation onto the information set (Ω_{t-1}). The model implies that

---

[12] *In Black (1974), negative τ_j values are interpreted as subsidies since he assumes proportional investment barriers.*

no one can use the information set to forecast the deviation from the mode. So, if we work on the subset of data (Z_{t-1}), GMM economically implies the same result. Since we have all information, we still cannot predict the deviation; if we had less information we should not be able to predict the deviation as well (for details of the GMM estimation, refer to Appendix 3). Consequently, with this separation of specification test, I can interpret the significant τ_j as investment barriers.

2. Hypothesis:

To test whether capital markets are integrated, the hypothesis is:

$$H_0 : \quad \tau_j \quad = \quad 0$$

The test is a binational system[13] between Thailand and its five major investor countries. Therefore, the results will give five τ_j which may vary across countries. If markets are segmented, τ_j will be non-zero.

3. Empirical Test for Integration

I chose Hong Kong, Japan, Singapore, the UK, and the US as foreign investor countries because these nations are major foreign investors in Thai equities (see Table 4-5). Returns are compounded both monthly and continuously and measured in the corresponding local currencies, as from a foreign investor's perspective. The Thai equity portfolio will be constructed exclusively from the eligible assets as determined by the method described above. The Thai returns are converted to returns measured in the respective currencies of the foreign countries using the end-of-the month exchange rates. The risk-free returns are short-term interest rates in the investor countries.

---

[13] *The binational system is appropriate since the smaller the number of equations, the more accurate the rejection rates of the asymmetric $\chi 2$ statistics are.*

Table 4-5: Net Flows of Foreign Investment Equity (%)

	1992	1993	1994	1995
Japan	18.21	20.94	22.45	26.39
Hong Kong	26.35	12.37	20.28	13.44
Singapore	4.54	2.51	4.17	7.30
US	27.20	14.57	11.23	13.42
of which :				
UK	5.41	10.06	1.82	2.05
Others	23.70	35.78	40.05	37.40

Source : Bank of Thailand Monthly Statistic Bulletin, February 1996

The proposed variables and the economic intuition are as follows:

- a lagged return on the Morgan Stanley Capital International Perspective (MSCI) world portfolio;
- a lagged measured of inflation in industrialized countries;
- a lagged difference between the one year and one month Eurodollar interest rate; and
- a lagged change in oil prices.

These variables were selected by many studies such as Chan, Chen and Hsieh (1985), Chen, Roll and Ross (1986), and Khanthavit and Sungkaew (1993). The economic intuition for choosing the above variables is that these sets of instrumental variables should replicate the information investors use to predict prices. Harvey (1991)[14], Solnik (1993), and Campbell and Hamao (1992) document that returns on many international equity portfolios are predictable. The common instrument set, identical for all markets, contains information about the global market. The selection of instrumental variables draws on previous studies. The common instrumental

[14] *Harvey (1991) finds that 2 of 17 countries are influenced by local information.*

variable used in most previous studies is a lagged return on the world market portfolio. Fama (1970) among others have found autocorrelation in returns. A lagged measured of inflation is included because it can be a source of economic risk if inflation has real effects that are not neutralized in the cash flows and the discount rate. The term premium is calculated as the lagged difference between the one year and one month Eurodollar interest rate. Campbell and Hamao (1992) show that measures of the term structure statistically explain returns in Japan and the US. The last instrumental variable is an oil price factor. A number of researchers have found that shocks in crude oil price have important effects on stock returns.[15] I specify this factor as the lagged change in the US dollar price per barrel of crude oil. Moreover, when these state variables were used in earlier studies, the expected excess return can be predicted with a high power, leaving the forecasting errors serially uncorrelated which is the necessary condition of the latent-variable model.

4. Results -- Latent Variable Tests of Market Integration

Finally, Thai eligible asset monthly returns during 1988-1992 are constructed and continuously compounded. Table 4-6 presents the means and standard deviations of excess returns. The data are calculated for the whole sample period and for two sub-periods, January 1988 to December 1992 and January 1993 to December 1995. For all stocks of the investor countries, the mean excess returns were higher in the second period than in the first period. The standard deviation of the investor countries (except Hong Kong and Singapore) were lower in the second period. For Thai stocks, regardless of the currency in which they are measured, the mean excess returns were

---

[15] *For example, Harvey (1995).*

lower in the second period. Standard deviations were lower in the second period except in the Singaporean and Japanese systems.

Table 4-6: Means and Standard Deviations of Excess Returns measured in each Investor Country's Currency

	Returns					
	Full Sample 1988 - 1995		First Sub Sample 1988 - 1992		Second Sub Sample 1993 - 1995	
Country	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. De.
Thailand	1.41	10.113	1.452	10.265	1.337	10.002
Hong Kong	1.049	7.687	1.047	6.830	1.054	9.006
Thailand	1.215	10.305	1.284	10.358	1.102	10.359
Singapore	0.752	5.540	0.591	5.533	1.014	5.618
Thailand	1.272	11.526	1.429	11.451	1.016	11.800
Japan	-0.521	6.763	-1.091	7.273	0.404	5.819
Thailand	1.238	11.362	1.286	11.922	1.211	10.550
UK	0.068	4.504	-0.085	5.135	0.316	3.283
Thailand	1.472	10.095	1.530	10.23	1.378	10.010
US	0.579	3.146	0.534	3.631	0.651	2.184

Table 4-7 reports the results of tests of the predictability of stock returns since predictability of stock returns are necessary to employ a latent-variable technique. To test for predictability, I use the ordinary least squares procedure to regress $R_{i,t}$ on Z_{t-1}. Wald statistics are performed to test whether the projection coefficients are jointly zero. The null hypotheses are that the projection coefficients and the projection coefficients except the constant are jointly zero. Under the null hypotheses, W_5 and W_4 are distributed as $\chi^2_{(5)}$ and $\chi^2_{(4)}$, respectively. Results are presented for the whole sample period (Panel A) and two sub-samples: January 1988 - December 1992 (Panel B) and January 1993 - December 1995.

Table 4-7: Tests of Predictability of Excess Returns using OLS Regression of Excess Returns Measured in Currencies of Each Investor Country

$$R_{i,t} - R_{f,t} = Z_{t-1}\alpha_i + e_{i,t}$$

Where Z_{t-1} consists of a constant

V_1 - a lagged return on the Morgan Stanley Capital International Perspective (MSCI) world portfolio;

V_2 - a lagged measured of inflation in industrialized countries;

V_3 - a lagged difference between the one year and one month Eurodollar interest rate;

V_4 - a lagged change in oil prices.

Wald statistic W_5, W_4 for the test of the coefficients and the coefficients except the constant are jointly zero. χ^2 - statistic is the Breusch Godfrey, Lagrange multiplier test for the test of zero serial correlation between lags 1 to 6. P values are in parentheses.

Panel A: Returns -- Full Sample -- January 1988 - December 1995

Country	C	V_1	V_2	V_3	V_4	W_5	W_4	χ^2
Thailand	-3.08	0.28	-2.96	0.23	-1.12	22.95	7.77	0.33
	(2.99)	*(0.28)*	*(5.82)*	*(2.33)*	*(0.60)*	*(0.00)*	*(0.10)*	*(0.92)*
Hong Kong	-3.44	0.00	-3.27	0.79	-0.28	30.36	21.50	0.48
	(2.39)	*(0.23)*	*(4.66)*	*(1.88)*	*(0.48)*	*(0.00)*	*(0.00)*	*(0.82)*
Thailand	-1.31	0.26	-2.09	-0.79	-1.27	14.09	8.86	0.44
	(3.00)	*(0.29)*	*(5.84)*	*(2.76)*	*(0.60)*	*(0.02)*	*(0.07)*	*(0.85)*
Singapore	-2.46	0.10	-1.42	0.18	-0.91	37.24	12.12	0.26
	(1.66)	*(0.16)*	*(3.23)*	*(1.30)*	*(0.33)*	*(0.00)*	*(0.02)*	*(0.95)*
Thailand	-1.07	0.36	-3.67	-0.73	-1.13	13.26	7.75	0.63
	(3.36)	*(0.32)*	*(6.55)*	*(2.64)*	*(0.68)*	*(0.02)*	*(0.11)*	*(0.71)*
Japan	-4.24	0.21	-1.58	0.51	-0.47	41.28	14.00	1.58
	(2.21)	*(0.20)*	*(4.31)*	*(1.67)*	*(0.43)*	*(0.00)*	*(0.01)*	*(0.16)*
Thailand	-6.64	0.43	-5.49	2.77	-1.16	50.76	9.75	0.51
	(3.38)	*(0.32)*	*(6.57)*	*(2.65)*	*(0.68)*	*(0.00)*	*(0.05)*	*(0.80)*
UK	-7.05	0.02	-8.08	3.85	-0.46	324.26	25.91	2.62
	(1.47)	*(0.14)*	*(2.85)*	*(1.15)*	*(0.29)*	*(0.00)*	*(0.00)*	*(0.02)*
Thailand	-2.22	0.24	-2.97	0.00	-1.10	18.09	16.50	0.40
	(2.94)	*(0.28)*	*(5.72)*	*(2.31)*	*(0.59)*	*(0.00)*	*(0.00)*	*(0.88)*
US	-3.11	-0.11	-4.15	1.64	-0.55	223.33	29.15	1.34
	(0.87)	*(0.08)*	*(1.70)*	*(0.69)*	*(0.18)*	*(0.00)*	*(0.00)*	*(0.25)*

Panel B: Returns -- First Sub-Sample - January 198 - December 1992

Country	C	V_1	V_2	V_3	V_4	W_5	W_4	χ^2
Thailand	-6.60	0.52	2.96	0.24	-1.41	24.19	10.62	1.05
	(3.79)	*(0.33)*	*(7.07)*	*(3.50)*	*(0.65)*	*(0.00)*	*(0.03)*	*(0.40)*
Hong Kong	-6.92	0.12	0.47	3.79	-0.60	35.96	24.55	0.31
	(2.76)	*(0.24)*	*(5.14)*	*(2.54)*	*(0.47)*	*(0.00)*	*(0.00)*	*(0.93)*
Thailand	-4.95	0.50	3.65	-0.22	1.59	17.94	12.42	1.10
	(3.74)	*(0.32)*	*(6.97)*	*(3.45)*	*(0.64)*	*(0.00)*	*(0.01)*	*(0.38)*
Singapore	-4.88	0.15	1.28	1.07	-1.09	43.57	14.53	0.30
	(2.04)	*(0.18)*	*(3.81)*	*(1.89)*	*(0.35)*	*(0.00)*	*(0.01)*	*(0.94)*
Thailand	-5.85	0.64	3.79	-0.14	-1.48	18.15	11.19	1.63
	(4.14)	*(0.36)*	*(7.72)*	*(3.82)*	*(0.71)*	*(0.00)*	*(0.03)*	*(0.16)*
Japan	-7.96	0.09	2.27	1.43	-0.79	44.59	14.70	0.59
	(2.03)	*(0.24)*	*(3.28)*	*(2.61)*	*(0.49)*	*(0.00)*	*(0.01)*	*(0.74)*
Thailand	-12.39	0.67	3.14	2.70	-1.51	50.84	10.78	1.44
	(4.39)	*(0.38)*	*(8.81)*	*(4.05)*	*(0.75)*	*(0.00)*	*(0.03)*	*(0.22)*
UK	-10.62	0.04	0.25	4.19	-0.63	304.27	14.40	0.96
	(1.89)	*(1.60)*	*(3.53)*	*(1.71)*	*(0.32)*	*(0.00)*	*(0.01)*	*(0.46)*
Thailand	-5.34	0.48	2.37	0.12	-1.37	20.06	10.54	1.12
	(3.69)	*(0.32)*	*(6.88)*	*(3.40)*	*(0.63)*	*(0.00)*	*(0.03)*	*(0.36)*
US	-3.45	-0.17	-4.74	2.44	-0.66	168.51	27.40	0.77
	(1.21)	*(0.10)*	*(2.25)*	*(1.11)*	*(0.21)*	*(0.00)*	*(0.00)*	*(0.60)*

Panel C: Returns -- Second Sub-Sample - January 1993 - December 1995

Country	C	V_1	V_2	V_3	V_4	W_5	W_4	χ^2
Thailand	5.65	-1.18	-13.03	-3.31	2.78	9.45	7.43	0.49
	(4.88)	*(0.64)*	*(11.19)*	*(3.69)*	*(1.86)*	*(0.10)*	*(0.10)*	*(0.81)*
Hong Kong	-2.61	-0.22	1.20	-1.13	0.49	13.38	8.48	0.37
	(0.98)	*(0.12)*	*(2.26)*	*(0.74)*	*(0.37)*	*(0.02)*	*(0.08)*	*(0.89)*
Thailand	7.85	-1.30	-11.25	-5.31	3.01	7.25	6.57	0.34
	(4.96)	*(0.65)*	*(11.35)*	*(3.75)*	*(1.88)*	*(0.20)*	*(0.16)*	*(0.91)*
Singapore	-2.19	-0.53	-3.64	-1.52	0.93	7.02	4.61	0.90
	(1.43)	*(0.19)*	*(3.27)*	*(1.08)*	*(0.54)*	*(0.22)*	*(0.33)*	*(0.51)*
Thailand	10.02	-1.39	-14.66	-6.08	3.52	7.05	6.69	0.61
	(5.61)	*(0.74)*	*(12.85)*	*(4.24)*	*(2.13)*	*(0.22)*	*(0.15)*	*(0.72)*
Japan	0.51	0.10	2.79	-5.32	1.19	11.52	8.02	2.21
	(2.76)	*(0.36)*	*(6.31)*	*(2.08)*	*(1.65)*	*(0.04)*	*(0.09)*	*(0.07)*
Thailand	4.74	-1.23	-14.68	-3.00	2.96	12.00	9.66	0.27
	(5.04)	*(0.66)*	*(11.35)*	*(3.81)*	*(1.52)*	*(0.04)*	*(0.05)*	*(0.95)*
UK	1.94	-0.49	-0.85	-3.97	0.98	125.94	10.09	0.78
	(2.79)	*(0.37)*	*(6.39)*	*(2.11)*	*(3.06)*	*(0.00)*	*(0.04)*	*(0.59)*
Thailand	6.07	-1.23	-12.69	-3.78	2.78	7.76	5.63	0.43
	(4.88)	*0.64*	*11.19*	*3.69*	*1.86*	*(0.17)*	*(0.23)*	*(0.85)*
US	4.43	-1.12	-5.76	-6.30	3.54	93.86	9.66	0.21
	(4.21)	*(0.55)*	*(9.65)*	*(3.18)*	*(1.60)*	*(0.00)*	*(0.08)*	*(0.97)*

The results of these tests find that Hong Kong returns can be predicted by the set of instrumental variables, since the null hypothesis of jointly zero coefficients is rejected. For the Singapore system, the excess returns are predictable in the full sample and the first sub-sample, but not in the second sub-sample. All excess returns in the Japanese system are predictable except for Thai stocks measured in Japanese currency in the second sub-period. The results of the UK system does not support the null hypothesis of jointly zero coefficients. The coefficients are significant in both the full and sub-samples. All excess returns in the US system are predictable except for the Thai portfolio in the second sub-sample. However, the adjusted R^2 for each systems is not high, ranging from 9 to 16 percent (not reported in the table). Although the R^2 in regressions of one-step-ahead returns on instrumental variable set is quite small, the prediction of stock returns draws on other studies yielding similar results. For instance, Harvey explores the sensitivity of the emerging market returns to measures of global economic risk in the period of 1985 to 1992. The R^2s of her regressions range up to 20 percent. An another example, Bekaert and Hodrick (1992) apply the vector autoregression (VARS) to predict the equity return in the US and Japan and find that R^2 are not large. The lagged variables explain 6.3% of the US excess equity return and 5.2% of the Japanese excess equity return for 1981 to 1989 sample period. However, the signs of our coefficients are as we expected. The coefficients for the lagged return on the world portfolio are positive which implies that lagged returns contain information on the future returns[16] I found that excess returns

[16] *Fama (1965) points out that returns on the benchmark portfolio may be serially correlated.*

are negatively correlated with expected inflation and the lagged change in oil prices.

Since the models are developed under the orthogonality of the residual onset of information assumption, the forecasting residuals are required to be serially uncorrelated. To ensure that this condition is satisfied, χ^2 tests proposed by Breusch-Godfrey are estimated to test whether the residuals and lags 1 through 6 are uncorrelated. At a 5% significance level, the null hypothesis cannot be rejected for any case except for the excess return on the Japan equity portfolio in the second sub-sample and on the UK equity portfolio in the full sample period.

Table 4-8 reports the results of the single-latent variable models of market integration. Each model consists of two equations defined by equation system (7). The first equation describes each Thailand major investor's excess return and the other describes the Thailand excess return measured in the home currency of each major investor. There are 7 parameters in the system and each system has 10 orthogonality conditions. The minimized criteria's function values are reported under the j-statistic column. This statistic can be used to test the proportionality restrictions imposed by the model. If the model is correct, the j-statistics are distributed as a $\chi^2(3)$. P values are under the χ^2 statistics.

Table 4-8: Latent-Variable Tests of Market Integration

Tests of Single-latent-variable model with investment barriers is estimated:

$$R_{i,t} - R_{f,t} = \alpha' Z_{t-1} + U_{i,t}$$
$$R_{j,t} - R_{f,t} = \beta^{*}\alpha' Z_{t-1} + U_{j,t} + \tau_j$$

Stock *i* is domestic to the foreign investor whereas stock *j* is a Thai stock. All excess returns are in currencies of investor countries. J_i is Hansen's J statistic of the test of parameter restrictions. It is an $\chi^2(3)$ under the null hypothesis. Its P value is in parentheses. T_j is a measure of Thailand's barriers to investment perceived by investors in country *i* . Its t-statistic is in parentheses. The unit of T_j is percent per month.

	Full Sample		First Sub Sample		Second Sub Sample	
System	J_i	T_j	J_i	T_j	J_i	T_j
Hong Kong	1.4015	-0.008	1.39	2.85*	1.209	-0.030
	(0.705)	*(-0.001)*	*(0.708)*	*(1.94)*	*(0.751)*	*(0.056)*
Singapore	1.254	-0.057	3.383	3.03*	1.665	0.075
	(0.739)	*(0.076)*	*(0.354)*	*(2.67)*	*(0.645)*	*(0.065)*
Japan	2.235	-0.198	5.405	8.67*	2.424	0.171
	(0.525)	*(0.067)*	*(0.144)*	*(2.32)*	*(0.489)*	*(0.061)*
UK	0.912	-0.011	1.319	2.36*	1.031	4.42*
	(0.822)	*(0.074)*	*(0.725)*	*(2.02)*	*(0.794)*	*(1.96)*
US	2.40	0.005	3.383	0.89	1.912	1.05*
	(0.481)	*(0.089)*	*(0.354)*	*(1.85)*	*(0.612)*	*(2.30)*

From Table 4.8, the over-identification restrictions cannot be rejected for any of the five systems in the full sample, the first sub-sample or the second sub-sample. These results suggest that the model is not misspecified.

D. Results and Interpretation

Since the models are not rejected, τ_i can be interpreted as investment barriers. Market integration implies that τ_i are zero where as market segmentation expects τ_i to be significantly positive. I report values for τ_j, the investment barriers, after the J_i statistics, with the t-statistics shown in parentheses. Even though τ_j for all systems in the full sample are negative, they are small and insignificant. In the first sub-period for all countries, τ_j are large and significantly positive. I find that the barriers to investment during 1988 to 1992 perceived by Hong Kong, Singapore, Japan, the UK and the US investors are 2.85, 3.03, 8.67, 2.36 and 0.89 percent respectively. It should be noted that the sample is divided in this fashion to acknowledge changes in policy and the presence of more foreign investment. As discussed before, various policies were implemented in order to deregulate the market since 1992. Hence, the impact of these changes should be clearly visible after 1992.

In the second sub-period, τ_j for Hong Kong, Singapore, and Japan systems are quite small and insignificant while τ_j for the UK and the US systems are significantly positive (4.42 and 1.05 percent, respectively). From the findings, the investment barriers (τ_j) perceived by Hong Kong, Singapore and Japan investors are decreasing. The results are consistent with what we are expected since a number of restrictions to investment were relaxed during the period of study (such as adopting double tax treaties or relaxed exchange controls). In our framework, these results imply that the Thai market and these countries are more integrated compared with 1988-1995. Moreover, the insignificant τ_j means that any investment barrier not different from zero can be

referred to as completely integrated with the Thai markets. The opposite occurs in the case of the UK and the US systems. Investment barriers for UK and US investors are increasing. One interpretation is that the UK and the US markets are less integrated with the Thai market during 1982-1995, possibly reflecting the regional integration among Asian equity markets.

My findings are consistent with previous studies such as the paper of Arshanapalli, Doukas, and Lang (1995) who find evidence that supports the view of increased regional capital market integration among the Asian stock exchanges (Hong Kong, Singapore, Thailand, Malaysia and the Philippines). Moreover, they also suggest that during period January 1986 to May 1992, the Pacific Basin stock markets (including Thailand) were more integrated with the US market than they are with Japan. This evidence is also shown in my study. Investment barriers for Japanese investors were higher than barriers for US investors in the period of 1988-1992. Using a different sample set and a period, Khanthavit and Sungkaew (1993) also show that the investment barriers for Japanese investors exist and were higher than the barriers faced by US investors in the 1986-1989 period.

However, none of the previous studies have mentioned the degree of integration in the Thai market after 1992, the starting point for dramatic changes in policies to open up the economy. The fact that UK and US investors face more investment barriers during period of 1993 through 1995 whereas the barriers for Japanese, Singapore, and Hong Kong investors are decreasing is probably due to ineffectiveness of the liberalization process applied to international investors from the UK and the US, since barriers come

from many sources such as information costs or tax treatments. Comparing among these five major international investors, after 1992, one of the differences in investment barriers perceived by foreign investors is the tax treaty status. UK and US investors faced double tax treaties where as Hong Kong, Singapore, and Japanese investors do not. Another difference in barriers perceived by different foreign investor country may come from the information costs due to time zone difference between the US (the UK) market and the Thai market. Therefore, the aim to deregulate the Thai financial markets may have unequally impact on international investors.

However the barriers faced by the UK. and the US. investors may not increase significantly. To examine this issue further, I develop the estimation of the investment barriers which take into account the breaking point of sub-periods in order to test the significant difference between the barriers in the first sub-period and the barriers in the second sub-period. The statistical model is as follows:

$$R_{it} - R_{ft} = \alpha_i' Z_{t-1} + U_{it} \qquad (8.1)$$

$$R_{jt} - R_{ft} = \beta_j^* Z_{t-1}\, \alpha_j + \tau_{j1} D_1 + \tau_{j2} D_2 + U_{jt} \qquad (8.2)$$

Here, D_1 and D_2 are dummy variables. D_1 will equal one if the observations are from the first sub-period or zero if the samples come from the second sub-period whereas D_2 equal unity minus D_1. Then, τ_{j1} is the investment barriers measure in the first sub-period of 1988-1992 whereas τ_{j2} is the investment barrier for the period of 1993-1995. Thus, the over-identifying restriction in the model will equal 2 which is the degree of freedom of the chi-squared distribution.

Table 4-9 provides the results of equation (8) for the US and the UK system in order to determine whether τ_{j1} and τ_{j2} are equal or not. If the model is correct, J_i statistics are distributed as a $\chi^2(2)$. P-values are under the statistics. We are not able to reject the model with investment barriers for these two systems. We report T_{jk}s a measure of barrier *ti* investment, after the J_i statistics. Their t ratios are in parenthesis. For all systems, T_{jk} are large and significantly positive, although we find that τ_{j2} is larger than τ_{j1} . However, we further test the null-hypothesis that τ_{j1} equals τ_{j2} by using the general F* test statistic with 1 and n-6 degrees of freedom. I found that the difference between τ_{j1} and τ_{j2} is not significantly different from zero in the US system; τ_{j1} is not equal to τ_{j2} in the UK system. These observations imply that while the barriers faced by UK investors are higher in the first sub-period (1988-1992) than those in the second sub-period (1993-1995), significantly, the difference of the investment barriers faced by the US investors between theses two sub-period is not statistically supported.

Table 4-9: Latent-Variables Tests of Market Integration

Test of barriers to investment and tests of single-latent variable model with investment barriers is estimated:

$$R_{it} - R_{ft} = \alpha_i' Z_{t-1} + u_{it}$$

$$R_{jt} - R_{ft} = \beta^{*}{}' \alpha_i Z_{t-1} + \tau_{j1} D_1 + \tau_{j2} D_2 + u_{jt}$$

Stock *i* is domestic to the foreign investor whereas stock *j* is a Thai stock. All excess returns are in currencies of investor countries. J_i is Hansen's J statistic of the test of parameter restrictions. It is a $\chi^2(3)$ under the null hypothesis. Its P value is in parentheses. T_{j1} is a measure of Thailand's barriers to investment perceived by investors in country i for the period of 1988-1992 whereas T_{j2} is a measure of Thailand's barriers to investment perceived by investors in country i for the period of 1993-1995. Its t-statistic is in parentheses. The unit of T_j is percent per month.

System	J_i	T_{j1}	T_{j2}
UK	1.267 (0.453)	2.47 (2.94)	3.81 (2.75)
US	2.825 (0.749)	0.68 (2.26)	1.19 (2.53)

The explanation of why the investment barriers perceived by the UK investors are increasing may due to non-binding restrictions applied to them. As a result, the investment barriers measured from the tests are not the effective barriers that the UK investors should face. This leads to the incorrect conclusion that the UK is more segmented with Thai market.

E. Robustness Check

Before moving to the conclusion, I perform three additional tests of market integration between Thailand and its major investor countries using different sets of data. The purpose of the extra tests is to check the results obtained and the models for robustness.

1. Testing with Alien Board Data

Since the portfolios of foreign investors are unobserved, the previous section inferred the foreign portfolio holdings from the mutual fund portfolio holdings. The findings are reliable only if the assumption that mutual fund and foreign investors have the same criteria to select stocks for their portfolio is true. Moreover, I would like to overcome problem of unavailable historical data of mutual fund portfolio holdings in the period of 1988-1992. Therefore, a comparison of the results from a different data set should be conducted to test the consistency of the findings.

Sampling from the Alien Board will give the set of stocks traded by foreigners. Normally, foreigners submit order to the Alien Board only when they want to invest in a stock that has reach its foreign ownership limit, which is the reason is why I do not use this approach in the first place. Aside from foreign ownership restrictions, foreigner investors typically can use a nominee to acquire the stocks for them if they are not interested in their voting rights. However, I propose this data set in order to provide at least the comparative results. Since direct access to foreign investment is impossible, the existence of a stock listed on the Alien Board may at least imply some characteristic of

stocks preferred by foreign investors. However, only the active stocks will be counted in estimating the Thai eligible asset return for each period; the price of inactive stocks may lead to wrong conclusion since they are not chosen by foreign investors for that period.

a) Procedure for sampling from the Alien Board

Step 1

Include only stocks traded on Alien Board that have trading volume more than zero at each period.

Step 2

Use this group of stocks as the eligible categories for the period 1988-1992 and 1993-1995. The sample is divided in this fashion to acknowledge changes in policy and the presence of more foreign investment.

b) Data

The list of stocks traded on Alien Board which have non-zero trading during each period and their prices are obtained from Datastream International of the Dun and Bradstreet Corporation. I will construct the Thai eligible return from these stocks and adjust the semi-annually returns reported monthly.

c) Results from Robustness Check with Alien Board Stocks

The characteristics of stocks that were active for the period of 1993 to 1995 are presented in Table 4-10. Means and standard deviations of Thai

excess returns measured in the currencies of investor country are reported in Table 4-11.

For Thai stock returns regardless of the currencies in which they are measured, the mean excess returns were higher and standard deviations were lower in the second sub-period except in the UK system (UK excess returns were lower in the second sub-period). The difference in excess return of Thai stocks results from the effects of exchange rates against different currencies and also the effects of the risk free rate used in each system.

Table 4-12 reports the results of the predictability of stock returns. The model can predict the excess returns in the Hong Kong system. The results of the Singapore system reject the null hypothesis in the full and first sub-sample but not in the second sub-period. Thai excess returns in the Japanese system can be predicted in the full sample. In the first sub-sample, the excess return for the Japanese system can be predicted with correlation. The system of the UK has lower power of predictability. Thai excess returns in the US system are predictable except for those in the second sub-sample.

Finally, Table 4-13 presents the results of the test of market integration using the data set from the Alien Board. The J_i statistic shows that the model with investment barriers cannot be rejected in all systems. The reported τ_j values, a measure of barriers to investment, are also consistent with the prior results of τ_j in Table 4-9. In the whole sample period, the investment barriers in all systems are insignificant. In the first sub-period, τ_j for all countries are significantly positive with values of 1.45, 1.35, 5.72, 3.42 and 1.13 percent, respectively. I find that only investment barriers (τ_j) for the UK and US

systems are large and significant in the second sub-sample. Therefore, consistent with the results obtained before, I find that the barriers to investment perceived by investors from Hong Kong, Singapore and Japan are lower in the second sub-period than the first sub-period; investment barriers faced by UK and US investors are higher in the second sub-period compared to the first sub-period.[17]

Table 4-10: Descriptive Statistics of Characteristics of Stocks Traded on the Alien Board with Non-zero Volume During 1993-1995

Stock Characteristics	Mean	Std. Dev
Beta	0.94	0.21
MV	0.016	0.012
PE	29.04	87.51
Period	1832.63	729.13
Vol	6.89	2.28
EPS	7.74	8.95
DY	3.191	3.46

[17] *I also use an alternative procedure to construct the eligible asset by determining the characteristics of stocks that are actively traded in Alien Board. The same procedures used to determine eligible assets selecting sample from mutual funds are applied. The results are reported in Appendix 4. In short, the results are consistent with earlier findings.*

Table 4-11: Means and Standard Deviations of Thai Excess Returns Measured in Currencies of Investor Country

	Returns					
	Full Sample		First Sub-Sample		Second Sub-Sample	
System	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Hong Kong	0.97	10.279	0.666	10.784	1.460	9.570
Singapore	1.326	13.858	0.509	14.056	2.611	13.653
Japan	1.568	15.867	0.789	13.376	2.795	13.162
UK	1.775	14.39	1.983	15.252	1.449	13.162
US	1.023	10.277	0.768	10.745	1.424	9.641

Table 4-12: Tests of Predictability of Excess Returns using OLS Regression of Excess Returns Measured in Currencies of Investor Countries

$$R_{i,t} - R_{f,t} = Z_{t-1}\alpha_i + e_{i,t}$$

Where Z_{t-1} consists of a constant

V_1 - a lagged return on the Morgan Stanley Capital International Perspective (MSCI) world portfolio;
V_2 - a lagged measured of inflation in industrialized countries;
V_3 - a lagged difference between the one year and one month Eurodollar interest rate; and
V_4 - a lagged change in oil prices.

Wald statistics W_5, W_4 for the test of the coefficients and the coefficients except the constant are jointly zero. χ^2 for the test of zero serial correlation between lags 1 to 6. P-values are in parentheses.

Panel A: Returns -- Full Sample

System	C	V_1	V_2	V_3	V_4	W_6	W_4	χ^2
Hong Kong	-2.20	0.11	-4.99	0.46	-0.78	41.11	9.52	1.60
	(2.11)	*(0.19)*	*(4.16)*	*(1.63)*	*(0.42)*	*(0.00)*	*(0.05)*	*(0.16)*
Singapore	-0.61	0.09	-4.07	-0.51	-0.95	21.33	10.19	1.78
	(2.23)	*(0.21)*	*(4.39)*	*(1.72)*	*(0.44)*	*(0.00)*	*(0.04)*	*(0.12)*
Japan	-0.14	0.19	-6.25	-0.46	-0.77	19.73	8.64	2.12
	(2.58)	*(0.24)*	*(5.08)*	*(1.99)*	*(0.51)*	*(0.00)*	*(0.07)*	*(0.06)*
UK	1.88	-0.10	6.05	-0.34	1.03	18.90	5.71	3.07
	(3.44)	*(0.32)*	*(6.77)*	*(2.65)*	*(0.68)*	*(0.00)*	*(0.22)*	*(0.01)*
US	-1.52	0.68	-4.94	0.28	-0.78	33.60	9.48	1.42
	(2.07)	*(0.19)*	*(4.07)*	*(1.59)*	*(0.41)*	*(0.00)*	*(0.05)*	*(0.21)*

Panel B: Returns -- First Sub-Sample

System	C	V_1	V_2	V_3	V_4	W_6	W_4	χ^2
Hong Kong	-4.55	0.19	-1.76	1.42	-1.00	36.39	9.71	1.06
	(2.75)	*(2.23)*	*(5.19)*	*(2.48)*	*(0.46)*	*(0.00)*	*(0.04)*	*(0.39)*
Singapore	-3.19	0.18	-0.85	1.02	-1.21	21.02	10.59	1.35
	(2.92)	*(0.25)*	*(5.52)*	*(2.64)*	*(0.50)*	*(0.00)*	*(0.03)*	*(0.26)*
Japan	-3.78	0.31	-1.43	1.03	-1.07	21.14	8.58	1.86
	(3.33)	*(0.28)*	*(6.29)*	*(3.00)*	*(0.56)*	*(0.00)*	*(0.07)*	*(0.11)*
UK	0.64	0.11	7.81	2.05	0.66	15.81	3.67	1.27
	(4.25)	*(0.36)*	*(8.01)*	*(3.83)*	*(0.71)*	*(0.01)*	*(0.45)*	*(0.29)*
US	-3.59	0.17	-2.13	1.36	-0.99	30.58	10.07	0.79
	(2.66)	*(0.23)*	*(5.01)*	*(2.40)*	*(0.45)*	*(0.00)*	*(0.04)*	*(0.59)*

Panel C: Returns -- Second Sub-Sample

System	C	V_1	V_2	V_3	V_4	W_6	W_4	χ^2
Hong Kong	2.78	-0.59	-7.96	-3.09	1.66	11.35	4.44	1.00
	(3.30)	*(0.43)*	*(7.61)*	*(2.53)*	*(1.27)*	*(0.04)*	*(0.35)*	*(0.44)*
Singapore	5.00	-0.72	-6.48	-5.06	1.89	8.69	6.89	0.84
	(3.35)	*(0.44)*	*(7.71)*	*(2.56)*	*(1.29)*	*(0.12)*	*(0.14)*	*(0.55)*
Japan	6.99	-0.78	-9.59	-5.86	2.41	8.18	7.19	0.87
	(3.94)	*0.52)*	*(9.08)*	*(3.01)*	*(1.51)*	*(0.15)*	*(0.12)*	*(0.53)*
UK	7.62	-1.55	2.01	-5.65	6.78	13.45	11.31	3.22
	(5.68)	*(0.75)*	*(13.09)*	*(4.34)*	*(2.18)*	*(0.02)*	*(0.02)*	*(0.02)*
US	3.15	-0.64	-7.80	-3.14	1.16	9.89	4.62	0.93
	(3.31)	*(0.44)*	*(7.64)*	*(2.53)*	*(1.27)*	*(0.07)*	*(0.33)*	*(0.49)*

Table 4-13: Latent-Variable Tests of Market Integration

Tests of barriers to investment, tests of single-latent-variable model with investment barriers are estimated :

$$R_{i,t} - R_{f,t} = \alpha' Z_{t-1} + U_{i,t}$$
$$R_{j,t} - R_{f,t} = \beta^{*}\alpha' Z_{t-1} + U_{j,t} + \tau_j$$

Stock *i* is domestic to the foreign investor whereas stock *j* is a Thai stock. All excess returns are in currencies of investor countries. J_i is Hansen's J statistic of the test of parameter restrictions. It is a $\chi^2(3)$ under the null hypothesis. Its P value is in parentheses. T_j is a measure of Thailand's barriers to investment perceived by investors in country i . Its t-statistic is in parentheses. The unit of T_j is percent per month.

System	Full Sample		First Sub-Sample		Second Sub-Sample	
	J_i	T_j	J_i	T_j	J_i	T_j
Hong Kong	1.213	0.224	2.43	1.45*	2.061	0.056
	(0.749)	*(0.059)*	*(0.486)*	*(3.29)*	*(0.559)*	*(0.064)*
Singapore	(0.17)	0.036	1.10	1.35*	1.270	0.016
	(0.982)	*(0.076)*	*(0.781)*	*(2.06)*	*(0.736)*	*(0.036)*
Japan	1..293	0.153	1.040	5.72*	0.592	-0.014
	(0.731)	*(0.103)*	*(0.79)*	*(2.40)*	*(0.898)*	*(0.092)*
UK	1.902	0.187	1.830	3.42	0.913	6.97*
	(0.593)	*(0.223)*	*(0.608)*	*(2.78)*	*(0.819)*	*(2.89)*
US	2.372	0.012	0.718	1.13	1.03	2.74*
	(0.499)	*(0.011)*	*(0.869)*	*(2.34)*	*(0.800)*	*(2.71)*

2. Testing with Eligible / Ineligible stocks

As a second test for robustness, I further investigate ineligible Thai stocks which we defined as the stocks that are not preferred by foreign investors. The excess returns of the ineligible stocks are higher than the excess returns of the eligible stocks. This may occur because the domestic investors cannot diversify away the specific country risk in the same way that the foreign

investor can. Therefore, we would expect the excess return from the two groups of stocks to differ because of the diversification effect. The price difference of the eligible assets and ineligible assets may also result from the restrictive ownership of equity as pointed by Errunza and Losq (1989). Thus, the local investors may be willing to pay less for an eligible asset compared to an ineligible asset with identical risk. Another possible explanation comes from the size effect since according to Table 4-3, the ineligible stocks are small-capital firms. Previous studies found evidence that small firms typically generate higher returns. Next, I test the market integration using the ineligible Thai stocks to replace the eligible Thai stocks in order to calculate the domestic excess return. The model can detect the significant investment barriers from the first sub-period and second sub-period regardless of the system. The table of results is reported in Appendix 5. Thus the results using ineligible stocks as the domestic stocks selected by foreign investors gives an answer different from what we found in the previous sections. The rejection of market integration must come from the wrong set of assets used in the test.[18] As mentioned before, the significant T_js may be explained by noting that the much higher risk premium demanded for the ineligible assets are combined into the estimated barriers (τ_js).

[18] *The table that summarized the results of market integration using the market index is presented in Appendix 6. As discussed before, market index is weighted average from all stocks in the markets , therefore, it should not be used as the data set. If one uses the market index instead of set of eligible assets, one would expect to find the evidence of significant barriers and lead to wrongly reject the hypothesis of market integration. Our results are consistent with this expectation.*

3. Further Examination

The source of investment barriers are either because of direct impediments to international investment such as restrictions imposed by local government or indirect restrictions due to information asymmetry among the investors. Therefore, one difficulty arises when attempting to explain the source of market segmentation. The following tests are conducted at least to shed some lights to investigate into this issue ; source of segmentation. The set of eligible assets is further classified into two set ; financial or non-financial since the ownership limits vary across these two groups of eligible assets. Next, the tests of market integration are performed using theses two data set. The results are reported in Appendix 7. In short, we find that the existence of investment barriers in both data set. Moreover, the barriers found in the case of non-financial eligible assets are larger that ones in the case of financial eligible assets. The results show the possibility that the direct barriers may not be binding from the foreign investors' perspective. However, to make the absolute conclusion, the more specific market structure should be used in future research.

F. Summary

In this study, I employ a single latent-variable model with investment barriers to test the market integration hypothesis. Using this approach, the model misspecifications can be examined separately before performing the test of market integration that implies zero investment barriers. Hence, we can overcome the issue of the joint test of market integration and the selected pricing model by applying the GMM technique. If the model is well specified,

thus, the rejection of the model is clearly interpreted as evidence of market segmentation. Furthermore, the appropriate data set proposed by our study allows direct testing for international market integration. As a result, the investment barriers in Thai equities from the perspective of foreign investors are attempted to measured. In general, I find that the model performs well since the j-statistics show that the model with barriers cannot be rejected in all systems.

I cannot detect significant barriers for any country in the full sample. Barriers exist for Hong Kong, Singapore and Japan investors during 1988 and 1992; however the barriers for these countries disappear during 1993 through 1995. The results are consistent with financial deregulation gradually introduced over time. In the cases of the UK and US systems, I find that investment barriers are positive and significant in both sub-periods, but higher in the second sub-period. Investment barriers come from many source such as information costs, limitation of foreign ownership, and differential tax treatments on capital gains and dividend income. When investigating the extent of market integration between the Thai market and markets in its major investor countries, the investment barriers (τ_j) should differ across countries. One of the reasons for the differences should be tax treaty status. Therefore, investment barriers (τ_j) would differ between nations that have tax treaties with Thailand, and those that do not.

Because of numerous types of barriers, some restrictions may be more important than others across different countries. The increasing barriers faced by the UK and the US investors may be due to non-binding restrictions leading

the barriers faced by the UK and the US investors to be ineffective. As a result, it may be a mistake to conclude that the UK and US markets are less integrated with the Thai market.