The Effects of International Intermarket Investment Barriers on Asset Pricing: The Case of the Singapore Stock Exchange

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This paper examines the effect of unidirectional intermarket investment barriers on asset prices in the Singapore stock market. The results show that identical stocks trade at a significant price difference when legal restrictions on foreign holdings of indigenous equity are binding. Foreign investors are willing to offer a premium, and local investors demand a discount, for otherwise identical stocks. The results from a pooled regression show that the foreign ownership restrictions, relative liquidity, and the correlation between Singapore and world market portfolios explain significantly the cross-sectional variation in the daily price premiums.

INTRODUCTION

Most theoretical developments in international finance and macroeconomics are based on the notion that world capital markets are perfectly integrated. The pricing models also assume that expected returns and asset prices are determined in an internationally integrated financial environment in which an identical asset is traded at the same risk-adjusted price in all markets. Price discrepancies between two markets are arbitraged because there are no intracountry or intercountry restrictions on capital flows.

Restrictions on capital movements across markets produce segmented markets. In a perfectly segmented market there are absolute restrictions on the free flow of capital, as for example when country A investors are prohibited from trading in country B securities and country B investors are prohibited from investing in country A securities. There are numerous sources of market friction (segmentation), including discriminatory taxes, capital constraints (Eun and Janakiramanan, 1986), lack of information, uncertainty about

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investments and corresponding economic systems, differences in accounting disclosure requirements, and restrictions on ownership of foreign securities.[1]

It is difficult to observe fully integrated (no barriers to international investments) or segmented (absence of international investments) international capital markets. Reality lies in the gray area of mildly segmented markets in which investors have opportunities to diversify their portfolio risk internationally but these opportunities come with costs and/or impediments.

Several capital markets around the globe have explicit investment restrictions, such as prohibitions on foreign ownership of domestic securities, that create barriers in direct portfolio investments.[2] The question of how mildly segmented markets affect pricing and returns of financial asset has only recently attracted attention.

For example, Hietala (1989) examines the Finnish capital market using a time period when local residents were totally restricted from buying foreign securities and foreigners were partially restricted in investing in Finnish stocks. Bailey and Jagtiani (1994) analyze the capital market of Thailand in which Thai and foreign residents face partial restrictions in investing abroad. Bergstrom, Rydqvist, and Sellin (1993) derive a formal valuation model to study the asset pricing and portfolio choice in Sweden where domestic investors face constraints on foreign investments and foreign investors face domestic equity ownership restrictions. Stulz and Wasserfallen (1995) focus on asset pricing in Switzerland in which restrictions on foreign equity ownership are not legally mandated but are made voluntarily by individual companies. Bailey (1994) studies Chinas new stock markets that offer B shares targeted at nonresident investors whereas resident Chinese investors trade in a different class of A shares. Most recently Domowitz, Glen, and Madhavan (1997) offer evidence of asset pricing, under market segmentation in the emerging market of Mexico.

This study examines the effects of investment barriers using data from the Singapore stock exchange in which foreign investors face local equity ownership restrictions whereas domestic investors are free to invest in foreign markets.

OWNERSHIP RESTRICTIONS IN SINGAPORE CAPITAL MARKET

Singapore regulations permit companies to impose restrictions on foreign holdings of equity ownership of indigenous firms in some industries. In most cases foreigners, in aggregate, are not permitted to buy shares of common stock of a firm in excess of a limit that varies between 20 percent and 30 percent. Certain industries and firms across industries are allowed to increase the limit on equity holding restrictions if the shareholders and the stock exchange agree to certain amendments to the corporate articles. For example, foreigners can hold shares of banks up to 35 percent. In other sectors the ownership percentage is even higher, 45 percent to 55 percent. In defense-related industries the mandated

[1] Jorian and Schwartz (1986) classify market frictions in two categories: indirect barriers and legal barriers. Indirect barriers include impediments based on traditional practices such as reluctance to deal with foreigners. Legal barriers include restrictions on foreign investments imposed by governments.

[2] For example, in Indonesia, India, and Mexico foreigners can buy up to 49 percent of the shares of a local firm. In Finland and France the limit is 20 percent. In Malaysia foreigners can hold up to 20 percent of shares in banks, up to 30 percent in natural resources, and a maximum of 70 percent in other firms. For further details see Eun and Janakiramanan (1986).

limit of foreign holdings is less than 25 percent. Some firms and industries are allowed to choose their own foreign equity ownership restrictions.[3]

The Singapore government does not impose any restrictions on the residents of Singapore with regard to their holdings of foreign securities and investments. The residents are free to invest abroad.

The Singapore market is a classic example of a mildly legally segmented market because the capital restriction flow is unidirectional. The intent of these restrictions appears to be the same as in other countries: to ensure local control of domestic firms, especially for those firms and industries strategically important to national interests. The Singapore stock market is not the only market with legal restrictions on foreign ownership. The market is, however, well-suited for an examination of asset pricing in mildly segmented markets. Singapore maintains two separate listings for common stocks—one is local listings and the other is foreign listings (or local counter stocks and foreign counter stocks). A stock is traded on the local counter before the foreign holdings reach the regulatory limit. The same stock begins simultaneous foreign counter trading once the foreign ownership reaches the limit; at this point the share certificates owned by foreigners are tagged as foreign shares to be traded on a separate counter but with the same company name. Thus, an identical stock, in terms of dividends, voting rights, and other characteristics, is simultaneously traded under *dual listings status*. Foreign counter prices are typically higher than the prices on the local counter which shows that the Singapore government has enforced the system in which intramarket arbitrage opportunities are impossible. The locals can not buy cheap (from local counters) and sell high (at the foreign counter). Indonesia, Thailand, and Turkey also follow a similar practice that prohibits intramarket arbitrage.

The restriction on foreign holdings of Singapore stocks was not binding until 1985. Prior to 1985 all local stocks were traded at only one counter, the local counter. Locals and foreigners traded at the local counter with a single price quotation.

In the late 1970s and early 1980s foreign ownership interest increased. As more and more shares were bought by foreigners, brokers found it difficult to find a willing seller at the single quoted price (which was too low, given the rising demand for the stocks). An unlisted market developed in which stocks were traded at a much higher price than the quoted price. Facing this situation, the Singapore stock exchange began to quote companies' local and foreign stocks separately. Thus, the intermarket investment barriers and excess foreign demand provided an economic justification for the creation of separate markets for the local and foreign shares of domestic equity. The significant presence of price differences among otherwise identical stocks shows that there exists an effective intramarket segmentation produced by international investment restrictions. It also means that a local Singapore stock, if traded at other foreign markets, will attract prices different than the local counter prices because of legal restrictions on foreign ownership.

This paper explains why the foreign listed stocks trade at prices greater than those of identical stocks traded at the local counter. We examine several factors that explain the

[3] The Singapore law makes the market partially segmented. The other barriers to investment, namely the "indirect barriers" (as termed by Jorian and Schwartz, 1986) such as lack of relative information about foreign firms, are applicable to the Singapore situation as much as they are applicable to other countries.

premium. Our study provides evidence regarding the extent of segmentation/integration of financial markets. Our examination of the effect of unidirectional investment barriers (and other indirect frictions) provides policy implications for privatization of government-owned companies and for the operation and design of emerging capital markets.

ASSET PRICING MODELS IN AN INTERNATIONAL CONTEXT

Most international asset pricing models are based on an assumption of international capital market integration: that capital can flow across countries without restrictions.[4] These models focus on exchange risk of the pricing of assets and assume that no impediments exist in integrating capital markets. For example, see Solnik (1974), Grauer, Litzenberger, and Stehle (1976), Alder and Dumas (1975), and Stulz (1981).

Black (1974) was the first to develop a model of capital market equilibrium in which there are explicit barriers to investment across national boundaries. Black assumes that the barriers to international investment take the form of a tax on the value of an individual's holdings of assets in countries other than his or her own. The tax represents various barriers to the international flow of capital, such as the "possibility of expropriation of foreign holdings, direct controls on the import or export of capital, reserve requirements on bank deposits and other assets held by foreigners, restrictions on the fraction of business that can be foreign owned, and the unfamiliarity that residents of one country have with other countries."

Stulz (1981) presents a model that imposes a cost for domestic investors in the form of taxes on the absolute value of an investors' holdings of risky foreign assets (where, as in Black's model, an investor has to pay taxes in proportion to his or her net holdings of risky foreign assets). The theoretical model shows that assets that can be possessed without restrictions trade at an identical price, whereas assets that are subject to restrictions trade at different prices.

Errunza and Losq (1985) consider a situation in which country 1 securities can be purchased without restrictions by investors either in country 1 or country 2. Country 2 securities are restricted, however, in that investors in country 1 are prohibited from purchasing them. Their asset pricing model shows that country 1 securities would be priced as if markets were not segmented, whereas country 2 securities would be priced to command a positive super risk premium.

According to Eun and Jankiramanan (1986), asset pricing models attempt to determine the impact of a variety of barriers to international investment in a catch-all manner. They derive an asset valuation model under a specific barrier to international investment—restrictions imposed by a government on holding of equity by foreign investors. Their model focuses on a situation in which residents of one country (foreign) are free to invest in securities of the residents of another country (domestic); however, the residents of a domestic country are partially restricted to invest in the securities of a foreign country. This case represents many markets where nonresidents are not allowed to own more than a certain percentage of a local firm.

[4] Lessard (1983) and Cooper and Kaplanis (1986) also examine the asset pricing in non-integrated markets. The implications of fully and partially segmented markets for corporate financial policy have been studied by Rubinstein (1973), Alder and Dumas (1975), Stapleton and Subrahmanyan (1991), Alexander, Eun, and Janakiramanan (1987, 1988), Joseph and Ziran (1991), and Stulz (1995).

The asset pricing model of Eun and Janakiramanan shows that, subject to equity ownership constraints, foreign securities are priced differently by foreign and domestic investors. This differential pricing reflects the premium offered by domestic investors and discounts demanded by foreign investors.

The rationale is simple. Given intermarket unidirectional segmentation, diversification across national boundaries has an incremental value for domestic investors because they can diversify some of their home country's systematic risk and thus can earn a superior risk-adjusted performance. Domestic investors, therefore, will be willing to offer a premium for the constrained ownership of foreign securities because the exclusion of foreign securities from their portfolio will result in a diversification loss. Foreign investors, on the other hand, do not face a restricted opportunity frontier; therefore, they can receive diversification gains without offering a premium for the domestic securities. The less divergent the two markets are, the higher the diversification benefits, the higher the premium the domestic investors will be willing to offer, and the higher the discount the foreign investors will demand for foreign securities. Also, the higher the restrictions imposed on foreign equity ownership, the higher the premium a domestic investor will be willing to offer to avoid diversification loss.

DETERMINANTS OF THE PRICE PREMIUM OFFERED BY FOREIGN INVESTORS

We use primarily the same explanatory variables as previous studies to examine the cross-sectional variance in the price premiums in various global markets. We define the price premium as the ratio of the price of foreign listed stocks and the otherwise identical locally listed stocks. Table 1 presents the descriptive statistics of price and the premium of foreign and locally listed stocks. Each foreign listed stock was traded at a price higher than the price of its locally listed counterpart. The average premium was 22 percent, with maximum and minimum premiums equal to 50.99 percent and 3.45 percent. In most cases foreign shares were traded at a statistically significant premium. The premium is more than twice the standard deviation, indicating a significant t-statistic at the 5 percent level. These findings confirm the hypothesis that regulation-imposed intermarket restraints on capital flow produce intramarket segmentation in which an identical asset is traded at two different prices.

Given that the price premium exists for foreign listed stocks and varies across firms, the critical questions are what derives the premium and why does the premium vary across firms?

Foreign investors will be willing to offer a premium to invest in domestic Singapore securities because the absence of such investment would result in a diversification loss. The size of the premium depends upon the degree of divergence between Singapore and the world market indexes.[5] If the Singapore market is perfectly integrated with the global portfolio, then foreign investors will not experience any diversification loss if they do not invest in the local market. On the other hand, if two indexes behave differently, there are incremental benefits for foreign investors when they invest in the local market. Our first

[5] Most mutual funds from western industrialized countries (such as the United States, U.K., Germany, and France) invest in the Singapore market to gain diversification benefits.

hypothesis is that the premium offered by foreigners for indigenous stocks is inversely related to the correlation between the foreign and domestic equity portfolios. This hypothesis is consistent with the implication of the theoretical models of asset pricing in mildly segmented markets, specifically the model presented by Eun and Jankiramanan.

The foreign demand curve for Singapore equities may not be perfectly elastic, as assumed in traditional financial theories. There is, however, an increasing body of evidence to support the existence of an inelastic (downward sloping) demand curve for equity shares.[6] The model of Stulz and Wasserfallen (1995) shows that "if the demand for shares from domestic investors is more price elastic than the demand from foreign investors, the shares available to foreign investors trade at a premium relative to the shares available to domestic investors." The cross-sectional evidence obtained using Switzerland data supports their model.

Restrictions on foreign holdings of local Singapore equities are not the same across firms and industries. We hypothesize that the foreign demand curve is more inelastic for firms with higher restrictions on equity holdings by foreigners. Thus, the higher the equity restrictions, the higher the premium foreign investors will be willing to pay for local firms' shares.

Third, we hypothesize that foreign investors will be willing to pay higher premiums for liquid stocks traded at the foreign counter. Amihud and Mendelson (1986) and Khan and Baker (1993) show there is an inverse relationship between the liquidity of a stock and its required rate of return. Investors are satisfied with a lower return for a more liquid stock; thus, they are willing to offer a higher price.[7]

We further hypothesize that the foreign investors pay higher premiums for informationally diversified, well-known firms for which the cost of information search is low (and, therefore, the required rate of return is low). Merton (1987) models an economy in which an asset with a relatively small base of informed investors trades at a lower price compared to its price in a more informed environment. Investors appear to avoid assets for which they have relatively little information. It is reasonable to assume that foreign investors will be attracted to those local firms which are informationally recognized.

Finally, we use the spot exchange rate (trading date) and the one week and three months forward exchange rates to explain the cross-sectional variation in premiums offered by foreigners. The higher the exchange rate (price of Singapore dollar in terms of U.S. dollars), the higher are the potential profits accruing to foreign investors because foreign investors buy securities in Singapore dollars and repatriate gains in foreign currency. We use forward rates as a lead specification for future exchange rates at a time of rebalancing the portfolio, usually every three months. The efficiency of the Singapore currency exchange rate is well-documented.

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[6] See Bagwell (1991) for discussion, review, and implications of evidence of inelastic demand curve for equities. Loader and Zimmerman (1988) and Bailey and Jagtiani (1994) provide support for the presence of a downward sloping demand curve in Switzerland and Thailand markets, respectively.

[7] In the context of the Gordon valuation model the price of a stock increases (decreases) if the required rate of return decreases (increases), even if the cash flows remain the same.

DATA AND METHODOLOGY

We gather data for dually listed stocks from January 1988 to June 1996. During this period there were 17 securities that reached the limit of foreign holdings of local equity ownership and thus began simultaneous trading on local and foreign counters. We obtain the names of dually listed firms from the financial press (*Business Times*). The closing prices (daily, monthly, and quarterly) are obtained from the records of the Singapore Stock Exchange. The exchange rates data are obtained from the Monetary Authority of Singapore and from a month-end file extracted from PATS database at the National University of Singapore.

Closing prices are collected both for otherwise identical foreign-locally listed stocks. We use the log ratio of the foreign price and the local price as a dependent variable. We focus on the ratio because the wide variation in the price of these shares makes comparison of the difference between two prices less meaningful across firms.

We use two variables to capture the impact of potential diversification benefits on the premium offered by foreign investors. Our first explanatory variable is the absolute difference between the rate of change of the Singapore market index, the Straits Times Industrial Index (STII), and the Morgan Stanley World Index (MSWI). We denote this variable as I_t which is = $\Delta VSTII_t$ - $\Delta VMSWI_t$ where $\Delta VSTII_t$ and $\Delta VMSWI_t$ show change in the value of indexes on day t. To construct the second variable we estimate the correlation coefficient between the world and local indexes. We call this second variable CORR and use it to capture the diversification benefit (loss).

Following Bailey and Jagtiani (1994) we use two liquidity measures, relative liquidity and absolute liquidity. We compute the ratio of number of shares traded on the foreign counter and on the local counter. We express this ratio as $Rv_{jtd} = \frac{V_{jft}}{V_{jlt}}$, where Rv_{jtd} is the differential volume of security j on day t and V_{jft} and V_{jlt} represent shares traded at the foreign and the local counters, respectively. For the absolute measure of liquidity (AV) we use the daily number of shares traded at the foreign counter. As stated earlier, we hypothesize that the relative liquidity of foreign and local listings affects their relative prices.

Foreign investors will be willing to offer premiums for relatively large, well-known firms for which information search costs are low. We attempt to capture this effect by using size (S_j) (market capitalization) as an explanatory variable.[8]

We use three different daily rates of change in the exchange rate: E^1 = daily rate of change of spot exchange rate (S$/US$) E^2 = the seven day forward rate of change of exchange rate (S$/US$), and E^3 = three months forward rate of change of exchange rate (S$/US$). We express the variable foreign ownership limit on firm j as FOL.

Following previous studies that examine the effect of constrained equity ownership on asset prices, we initially run a cross-sectional regression of price premium on the stated explanatory variables. There are, however, potential estimation problems with a cross-sectional regression when the sample size is small. The standard least square estimates may not be efficient in the sense of possessing the least variance. Despite the estimation problems associated with a small sample size, past studies use cross-sectional

[8] We use the lagged value of size as an explanatory variable and avoid the use of the contemporaneous size variable in the regression equation because both the response and explanatory variables will have contemporaneous Pf and contemporaneous Pl causing the results to be less meaningful. Thus, the response and explanatory variables will be highly correlated, but such correlation will be spurious.

regressions.[9] Judge (1985), Greene (1993), Gujarati (1995), Hsiao (1996), and others state that it is common practice in applied econometric work to pool all the data and estimate a common regression in order to overcome the small sample size problem. This technique of estimation is called *pooled regression,* and it is applied to obtain a more efficient estimation without loss of information and inference of the regression model.

We pool the monthly (and quarterly)[10] cross-sectional and time series data and run a regression of price premium on multiple variables, as explained above. The results are presented in the next section.

EMPIRICAL RESULTS

Table 1 presents the average local and foreign prices, their premiums, and respective standard deviations for each firm in the sample.

Table 2 specifies the years in which a stock began simultaneously trading at the foreign and local counters.

Table 3 presents the results of the pooled least square regressions using monthly data corrected for heteroscedasticity. The price premium is regressed on multiple explanatory factors.

Equation (1) introduces CORR as an explanatory variable. This variable is the first independent variable to enter the regression equation because it has the highest multiple R (correlation) with the response variable (.531). Other variables (for example, I, RV, and FOR) have correlations of .497, .467, and .444, respectively, with the response variable. The regression result shows that the variable CORR is significant at the 1 percent level with the expected negative coefficient which indicates that foreign investors are willing to offer a higher (lower) premium the lower (higher) the correlation is between the Singapore and the world market portfolios. This result is consistent with the implications of Eun and Janakiramanan's (1986) model of asset pricing in mildly segmented markets.

In equation (2) the variable RV is added to the regression model. Although the variable I has the second highest simple correlation with the response variable, it is not included in the regression equation as an additional explanatory variable because it does not have the highest partial correlation with the response variable. The stepwise regression enters a variable, among all the candidate variables, into the equation that offers the highest partial correlation with the response variable. Hair, Anderson, and Tayham (1987) define the partial correlation coefficient as a tool that "measures the strength of the relationship between the criterion or dependent variable and a single predictor variable when the effects of the other predictor variables in the model are held constant." RV explains the highest variation in the response variable after controlling for the variation explained by the CORR variable. RV has a partial correlation coefficient of .51 which is the highest among all the remaining variables that were candidates for entry into the model. Thus, RV enters the regression equation. The results show that its sign is positive, as hypothe-

[9] For example, Bailey and Jagtiani (1994) examine 27 Thai firms; Bergstrom, Rydqvist, and Sellin (1993) examine 15 Swedish firms; and Stulz and Wasserfallen (1995) examine 19 Swiss firms that reached the foreign ownership limits. To overcome the problem of a small sample, we pool the monthly (and quarterly) cross sectional and time series data, and we perform the analysis on the pooled data.

[10] The results are shown only for pooled monthly data corrected for heteroscedasticity. The White correction for heteroscedasticity improves the results for both monthly and quarterly data.

Table 1—Descriptive Statistics for Local and Foreign Companies

Prices and corresponding premium of stocks that simultaneously traded at local and foreign counters of Singapore Stock Exchange January 1988 to June 1996

Company		Price		Premium (%)	
		Mean	Standard Deviation	Mean	Standard Deviation
SIA	Local	7.08	1.83	50.99	22.76
	Foreign	10.69	4.42		
SPH	Local	8.72	5.88	43.92	40.51
	Foreign	12.55	11.57		
STAERO	Local	2.33	0.39	16.31	7.77
	Foreign	2.71	0.55		
STE-E	Local	1.65	0.22	11.52	7.91
	Foreign	1.84	0.31		
STATU	Local	2.84	3.32	4.58	6.01
	Foreign	2.97	1.87		
STCOM	Local	1.10	0.19	17.27	5.93
	Foreign	1.29	0.24		
HLEONG	Local	3.95	0.35	24.56	8.50
	Foreign	4.92	0.51		
STSE	Local	2.03	1.02	23.65	13.16
	Foreign	2.51	1.48		
UOB	Local	6.06	4.17	28.88	16.89
	Foreign	7.81	6.77		
SPC	Local	2.26	0.34	19.91	13.61
	Foreign	2.71	0.57		
KHJC	Local	1.19	1.16	8.12	4.86
	Foreign	1.29	1.23		
OCBC	Local	8.54	4.14	32.67	20.66
	Foreign	11.22	6.84		
OUB	Local	5.82	2.76	23.02	13.89
	Foreign	7.16	4.03		
SBS	Local	6.69	3.92	24.07	15.26
	Foreign	8.30	5.36		
DBS	Local	9.57	1.43	34.38	24.58
	Foreign	12.86	5.87		
SINV	Local	1.74	0.63	3.45	5.26
	Foreign	1.80	0.25		
OUT	Local	3.61	1.50	6.65	4.05
	Foreign	3.85	1.60		

sized, and it is significant in the presence of CORR. Investors attach incremental value to relative liquidity of a stock and are willing to offer a premium. Also, the variable CORR is significant with the correct sign after the variable RV is included, indicating that variable CORR offers an incremental contribution in explaining the variation in the response variable once we account for the effect of variable RV. The variables together explain 46.1 percent of the variation in the response variable as measured by the adjusted R^2.

In order to select a new variable to include in equation (3) partial correlation coefficients are estimated for each variable not in the model. The variable FOR offers the highest particle correlation coefficients of .528; this variable then enters the model in the presence of CORR and RV. The variable FOR is highly significant, with the negative coefficients after we account for the effects of variables CORR and RV. The incremental significance of the variable FOR indicates that a tighter foreign ownership limit is associated with a higher premium offered by foreign investors. This result provides evidence to support the existence of a downward sloping demand curve for equities, specifically in the

Table 2—Years an Identical Stock Simultaneously Traded at Local and Foreign Counters Singapore Stock Exchange (1988-1996)

Company		1988	1989	1990	1991	1992	1993	1994	1995	1996
SIA	Local	X	X	X	X	X	X	X	X	X
	Foreign									
SPH	Local	X	X	X	X	X	X	X	X	X
	Foreign									
OCBC	Local		X	X	X	X	X	X	X	X
	Foreign									
UOB	Local		X	X	X	X	X	X	X	X
	Foreign									
SBS	Local			X	X	X	X	X	X	X
	Foreign									
DBS	Local			X	X	X	X	X	X	X
	Foreign									
SPC	Local			X	X	X	X	X	X	X
	Foreign									
KHJC	Local			X	X	X	X	X	X	X
	Foreign									
SAC	Local			X	X	X	X	X	X	X
	Foreign									
SSE	Local			X	X	X	X	X	X	X
	Foreign									
SEEL	Local				X	X	X	X	X	X
	Foreign									
OUB	Local					X	X	X	X	X
	Foreign									
SCS	Local						X	X	X	X
	Foreign									
SAE	Local						X	X	X	X
	Foreign									
HLEONG	Local							X	X	X
	Foreign									
QINN	Local								X	X
	Foreign									
OUT	Local								X	X
	Foreign									

presence of ownership restrictions. Variables CORR and RV retain their significance and sign after inclusion of the variable, FOR. The three variables together explain 61.1 percent of the variation in the price premium of the dually listed stocks.

No other variable reveals a significant partial correlation. Thus, on a single variable entry basis, equation (3) offers the best model.

We now extend our analysis beyond the stepwise procedure because of the well-documented limitations and shortcomings of this methodology. For example, Hair, Anderson, and Tayham (1987) point out that "a potential bias in the stepwise procedure results from the consideration for selection of only one variable at a time." James Kenkel (1995) notes that "a problem with stepwise regression is that at each step, all the estimated coefficients, standard deviations, and t statistics change." Gujarati (1995) suggests that choosing the model, as per stepwise, that gives the highest adjusted R^2 may be dangerous: "it is not unusual to obtain a high adjusted R^2 but find some of the regression coefficients are either statistically insignificant or have signs that are contrary to prior expectations." Pindyck and Rubinfield (1991) argue that "while stepwise regression can

Table 3—Multiple Regression of Pooled Monthly Premiums (n = 939)

Equation	C	CORR	RV	FOR	I	AV	S	E^3	Adjusted R^2
(1)	.192	-0.0078							
	(43.28)	(-14.87)*							.281
(2)	.214	-0.0093	0.0087						
	(21.74)	(-19.38)*	(14.87)*						.461
(3)	.188	-0.0067	.0053	-.0037					
	(8.74)	(.17.32)*	(12.32)*	(-13.88)*					.611
(4)	(.214)		.0068	-.0019	.0063				
	(14.89)		(5.21)*	(-11.14)*	(8.36)*				.426
(5)	-1.156	-.0049		-.0019		.0049			
	(-12.83)	(-9.32)*		(-7.89)*		(8.32)*			.397
(6)	-1.848	-.0078		-.0023		.0078	-.0001		
	(14.96)	(-7.89)*		(-5.82)*		(6.82)*	(-0.99)		.396
(7)	-2.36	-.0042		-.0048		.0100		.0031	
	(18.96)	(-4.28)*		(-6.87)*		(9.98)*		(1.79)	.400
(8)	.177	-.0031	.0048	-.0046			.008	.0028	
	(14.23)	(3.21)*	(4.28)*	(-4.83)*			(1.78)	(1.43)	.616

* Significant at the 1 percent level
** Significant at the 5 percent level
I = Absolute difference between the monthly rate of change in STII and MSWI;
FOR = Foreign ownership limit;
RV = Ratio of average monthly volume on foreign and local counters;
AV = Average monthly number of shares traded at the foreign counters;
S = Market value of a firm;
CORR = Correlation coefficient between the MSWI and the rate of return of the local price index;
E^1 = Average monthly rate of change in the spot exchange rate;
E^2 = Average monthly rate of change in a seven day forward rate; and
E^3 = Average monthly rate of change in a three month forward rate
(T-statistics in parentheses)

be useful in looking at data when there are large numbers of possible explanatory variables, it is of little value when one is attempting to analyze a model statistically."

In the spirit of the Eun and Janakiramanan (1986) model, we develop two different constructs, CORR and I to capture the diversification benefits accruing to foreign investors. We run regression (4) to examine the strength of the I variable with RV and FOR in order to compare the results with the results from equation (3) which utilizes CORR with RV and FOR.

Variable I, as expected, offers incremental contributions in explaining the variance in the response variable after we account for the effects of RV and FOR. The overall strength of model is much lower than in equation (3), as evidenced by decline in adjusted R^2 from .611 to .426. This drop indicates that variable CORR is a better construct in explaining the variation in the response variable.

We run equation (5) to assess the comparative effectiveness of liquidity constructs. Variable AV is brought into equation in the presence of CORR and FOR. The result shows that AV is significant with the expected sign (in the absence of another liquidity

construct of RV); however, adjusted R^2 of .397 is much smaller than the .611 that was obtained when RV was used in equation (3). Based on this result, it appears that RV is a better liquidity construct than AV in capturing variation in the price premium.

In equation (6) we introduce the size variable in the presence of variables AV, CORR, and FOR. The variable size, like all other remaining candidates for entry into the model, is insignificant after equation (3). That is, the marginal contribution of the variable size is insignificant after adjusting for the effects of variables CORR, FOR, and RV. Then we bring the variable size with AV (instead of RV), CORR, and FOR. The size variable is again insignificant with a wrong negative sign. It appears that the liquidity variables are correlated with the size variable. Thus, the incremental contribution of size variable is negligible after we account for the influence of the liquidity variable(s).

In equation (7) we introduce E as a variable together with AV, FOR, and CORR. The variable E^3 is insignificant while all other variables retain their sign and significance. We introduce E^1 and E^2 one by one, but neither is significant. (Their results are not shown)

Up to equation (7) we introduce one variable at a time. After equation (7) we run several regressions introducing two new variables at a time (not permissible under stepwise procedure). We present the results of one such regression in equation (8) in which we add the variables size and E^3 together. R^2 and adjusted R^2 did increase slightly; however, none of the variables is significant.

Despite the limitations and shortcomings of the stepwise procedure, the best model is equation (3), which is an outcome of stepwise procedure.

According to Judge *et al.* (1985) and Dielman (1989), the estimation of regression parameters based on pooled classical ordinary least squares (OLS) rests on certain assumptions including the assumptions of homoscedastic variances, zero covariance, and zero autocorrelations within (and among) cross-sectional groups. Greene (1993) explains that OLS estimates are still unbiased, consistent and asymptotically normally distributed, even if the underlying assumptions are violated; however, the estimates are not efficient.

Greene (1993), among others, suggests that one should use iterated feasible generalized least squares (FGLS) or maximum likelihood techniques for the efficient estimation of a model in the presence of group-wise hetroscedasticity,[11] group-wise correlation, and within (between) autocorrelation. Although we do not have a prior reason to assume the presence of group-wise correlations,[12] we perform numerous tests after relaxing the OLS assumptions. We do not observe any significant improvement in results.

We also do not have a prior reason for assuming that coefficients are not constant across cross-sections.[13] We estimate the model using iterated FGLS and allow coefficients to vary (intercept and slope variables) randomly. The results are invariant.

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[11] The hetroscedasticity problem can be corrected by using White's corrections or iterated FGLS. Our OLS estimates are based on White's correction. We also correct for hetroscedasticity using iterated FGLS.

[12] The reason is that firms in our sample come from well-diversified industries as opposed to narrowly concentrated firms in a few industries. Group-wise contemporaneous correlation is present in a clustered sample, and we do not have such a sample.

[13] Constancy of regression coefficients is another assumption for classical pooled OLS estimation. [See Dielman (1989) for details.]

SUMMARY AND CONCLUSIONS

This paper examines asset pricing in a mildly segmented market. The stock exchange in Singapore provides an interesting opportunity to evaluate the impact of investment barriers to foreign ownership on equity value.

We examine the price behavior of local and foreign listed stocks traded on the stock exchange of Singapore from January 1988 to June 1996 and find the presence of a significant premium offered by foreign investors. The results are consistent with previous studies of markets that impose equity ownership restrictions. Thus, our study provides evidence from an additional market regarding the effects of intermarket segmentation on intramarket asset prices. Also, the results are based on a research design consistent with the asset pricing model of partially segmented markets.

The results from pooled multiple regression show that variables such as correlation between Singapore index and foreign index, foreign ownership restrictions, and asset liquidity significantly explain variations in the price premium offered by foreigners.

The existence of a significant premium shows that the cost of equity capital for foreign investors is lower than the cost of equity capital for local investors. Thus, the value of the firm, and, consequently, the distribution of wealth among various classes of security holders will be impacted by the extent of required rates of returns differentials and foreign equity ownership restrictions. This evidence is pertinent to financial controllers and corporate planners who have voluntary restrictions on foreign ownership.

The presence of consistent price premiums offered by international investors is evidence that foreign investors value their investments in Singapore firms because they believe that they receive incremental diversification benefits. This finding may be useful for global fund managers seeking global diversification opportunities.

Many emerging markets are debating and considering numerous options regarding market design, i.e., the optimal structure and mechanics of markets. Evidence of price differentials on otherwise identical stocks from the Singapore stock exchange shows that the introduction of restrictions on foreign ownership of indigenous equity will produce price differences on otherwise identical assets. Regulators and policy makers cannot ignore the implications of these price differences for the value of local firms, the distribution of wealth among various classes of security holders, and the cost of attracting local and foreign equity capital.

In addition, the evidence indicates that high trading activity, lower information gathering (processing) costs, and privatization will serve as key factors in attracting foreign capital inflow for developing economies.

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