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**SEGMENTED VERSUS INTEGRATED CAPITAL MARKETS:
THE CASE OF DUALY LISTED STOCKS ON THE
TOKYO AND NEW YORK STOCK EXCHANGES**

Richard H. PETTWAY* and T. Craig TAPLEY**

Abstract. This paper analyzes prices and returns for seventeen stocks which are dually listed on the Tokyo and New York Stock Exchange. The empirical results indicate that the Japanese capital market is not segmented. Rather, it is fairly well integrated in a world context. Specifically, it is shown that (1) changes in the yen/dollar exchange rate is the primary factor for explaining differences in returns for the dually listed securities, and (2) a secondary factor is changes in return for the security's market of origin, not simply the market of trade. In addition, a cluster analysis indicates that there is no segmentation even on a macro-scale.

There are major cultural, governmental, and economic differences between Japanese and American markets. Much has been written about the many Japanese restrictions which supposedly keep their markets segmented and not subject to the full impact of world-integrated economic activities. The purpose of this paper is to determine if the apparent restrictions and cultural differences are significant enough to cause the market for equities in Japan to be segmented.

Past studies of equity prices listed on various stock exchanges of the world have been concerned with their efficiency, comovements, returns levels, and the merits of international diversification. Market efficiency of various world stock exchanges has been tested by Hong [8], Jennergren-Korsuold [14], D'Ambrosio [4], and others. The specific market efficiency of the shares listed on the Tokyo Stock Exchange (TSE) has been examined by Jaffe-Westerfield [12], Kato-Schallheim [15], Komine [16, 17], Lau-Quay-Ramsey [18], and Pettway-Tapley [24]. Agmon [3], Hilliard [6], Panton-Lessig-Joy [22], Ripley [25], and Robichek-Cohn-Pringle [26] have studied the comovements of world exchange indexes and stocks. Returns and wealth of international shares have been explored by Ibbotson-Carr-Robinson [10] and Ibbotson-Siegel [11]. Grubel [5], Levy-Sarnat [21], and Solnik [27] as well as others have investigated international diversifica-

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tion. Thus, there is an extensive and rich research literature on the stock exchanges of the world.

In addition to the studies of stock exchanges, Adler-Dumas [1], Adler-Horesh [2], Lessard [19, 20] and Stehle [28] have considered a related issue of segmented versus world-integrated markets. Protopapadakis-Stoll [24] studied the integration of commodities traded on international futures markets. Their study is unique in that it implicitly tests for world integration by determining how well the Law of One Price (LOP) holds for real assets. Generally, the research found that the lower the transportation costs and the lower the regulatory constraints, the more valid LOP becomes; yet, there were some commodities where large riskless arbitrage returns were possible.

Basically, the LOP states that the same asset, in a common currency, trading in two different markets can not trade, except for transportation costs, at different prices. If the LOP is violated, then it indicates that asset prices are reacting individually to factors specific to only one of the markets. Thus, in markets where the LOP does not hold for the same assets, these markets must be segmented because of institutional, cultural, or regulatory constraints.

This study continues the research on segmented versus world-integrated stock markets. It differs from previous studies that used cross-sectional regressions of various world stock exchange indexes which have either no or weak control for security risk differences. Because this paper examines the comovements of the *same* financial assets traded in two different markets and tests the validity of the LOP applied to these individual stocks, there are no differences in security risks between the markets. To determine precisely if the Japanese stock market is segmented or subject to world-integrated economic conditions, this paper examines the returns of seventeen stocks which are dually listed on the NYSE and the TSE.¹ Only through careful analysis of price and return movements of the *same assets* can the effects of institutional, cultural, or regulatory restrictions be measured. If the prices and returns of the same financial assets in two dissimilar markets react differently over time and violated the LOP, then it must be concluded that these markets are segmented.²

¹ During the study period, the dually listed Japanese companies are: Hitachi, Honda, Kyocera, Matsushita Electric Industrial Co., Pioneer Electric, Sony, and TDK. The American companies are Bank of America, Chase Manhattan, Citicorp, Dow Chemical, 1st Chicago, General Motors, I.T.T. Electric, I.U. International, IBM and Sperry Corporation. The Japanese firms may be generally classified as growth companies as they tend to pay low dividends and have high retention ratios. The American firms are predominately either banks or are large and well known companies. The dividend payout ratios of these American companies tend to be higher than for the Japanese firms. Three of the Japanese companies listed on the NYSE (Hitachi, Honda, and Matsushita) are traded in ADR units which are equivalent to ten regular shares of the same company on the TSE. The ADR unit traded on the NYSE of Kyocera, Pioneer, and TDK are equivalent to two shares of the same company traded on the TSE. Sony on NYSE has a one-to-one equivalence with the shares on the TSE.

² It should be noted that a rejection of the law one price (LOP) for dually listed securities would be a clear indication of market segmentation, but an acceptance of the LOP is not necessarily proof that markets are integrated.

Given well known institutional, cultural, and regulatory constraints there is reason to believe that securities traded simultaneously on the TSE and NYSE might violate the LOP. Japan is currently experiencing nonequalization of domestic and international markets in the balance of trade with the world, in domestic versus world interest rates markets, as well as in other markets. The Japanese government, especially the Ministry of Finance and the Ministry of International Trade and Industry, also has been accused of restricting and protecting the Japanese industrial and financial systems from the competitive pressures of world economic factors.

There are many major and unique features of the Japanese equity market that may cause differences in investors' expectations of returns. One very important distinction of the Japanese market is that profits made on the trading of shares listed on the TSE are exempt from Japanese capital-gains tax. Perhaps because there is no capital-gains tax on the trading of equity shares in Japan, Japanese firms tend to favor high growth, high retention, low payout of dividends, and high debt ratios.³ Additionally, there is an extensive amount of reciprocal equity ownership among Japanese businesses, especially between old *zaibatsus* and new large groups. In fact, reciprocal ownership also includes banks that own stock in the companies to whom they lend. Another important factor is that Japanese individuals generally do not view the purchase of equity shares as a form of saving or investing; many individuals consider it similar to gambling. Further, there are a large number of institutional differences in the way the two markets operate which could restrict the free flow of capital and information.⁴

³ The payout ratios of the following companies listed on the TSE illustrate the low payout of Japanese firms in 1981: Sony (18.6%), Matsushita Elec. Ind. (17.7%), TDK (14.7%), Honda (24.4%), Toyota (18.6%), and Nissan (24.2%). See [13]. Further, dividend payments in Japan are paid only twice per year compared to quarterly in the U.S. Yet, this low payout policy is not easy to understand when one realizes that dividends are taxed at the corporate level at lower rates than are earnings that are retained. For large companies, the current tax rate on income distributed as dividends is 32%, while it is 42% on income not distributed as dividends. Also, Japanese firms tend to have significantly higher degrees of financial leverage than American firms in similar industries. Japanese industrial firms typically have about 75% to 84% debt in their capital structure; whereas, American industrial firms typically have only 35% to 48% debt. Hodder-Tschoegi [7] reported total liabilities to total assets of 77.9% for nonfinancial firms listed on the TSE in 1983. These higher debt ratios for Japanese firms, along with historically lower nominal interest rates, have provided the Japanese firms generally with lower costs of capital than for their American counterparts.

⁴ For instance, before 1982 nonJapanese brokers were prohibited from being fully-participating members of the TSE, whereas Nomura and Daiwa Securities were full members of the NYSE. In early 1982, the 83 members of the TSE removed their prohibition against nonJapanese broker members. However, as of November 1983, the end of the study period, no foreign security firm was a full member of the TSE, although there were six nonJapanese brokerage firms operating in Japan under license by the Ministry of Finance: four American, one British, and one from Hong Kong. On February 1, 1986, well after the end of this study period, six foreign brokers were allowed full membership on the TSE. There were three American brokers (Merrill Lynch, Goldman, Sachs & Co., and Morgan Stanley & Co.); two British firms (Vickers de Costa, Ltd. and S. G. Warburg & Co.); and one from Hong Kong, Jardine Fleming (Securities) Ltd. Further, a foreign investor who purchases stock on the TSE must appoint either a Japanese resident or a resident corporation as his/her proxy. This is a costly

Recent research finds that there are some significant differences between the returns on Japanese versus American indexes and that there are some anomalies in Japanese stock returns. Using daily returns on two popular indexes of Japanese stocks and the S&P 500, Jaffe-Westerfield [12] find that there are significant differences between Japanese and American stock returns in terms of the day of the week patterns. Using daily returns of specific individual listed securities and portfolios, Pettway-Tapley [23] also report different day of the week patterns between the TSE and the NYSE. Using monthly returns, Kato-Schallheim [15] find that there are seasonal and size anomalies in Japanese stocks returns, especially the possibility of a January as well as a June seasonal effect. Thus, there is evidence that stock returns on the TSE are not completely similar to American stock returns. This may be an indication that the TSE is segmented.

The purpose of this paper is to more rigorously determine if Japanese restrictions, constraints, and cultural differences are significant enough to cause the prices and returns of dually listed securities to violate the LOP, which would indicate that the Japanese markets are segmented.

I. METHODOLOGY AND DATA

The patterns of prices and returns on the TSE and the NYSE, for the same security, are critical for determining if the LOP holds, and consequently whether one or both of the markets are segmented. If the patterns of prices on the TSE are not similar to the patterns of prices on the NYSE for the same security, then the LOP is violated and restrictions exist which curtail the free flow of capital and information. In essence, if there appears to be arbitrage possibilities, but investors are unable to act on these possibilities, then the two markets are segmented or artificially isolated from each other.

The ability to arbitrage is important if the LOP is to hold. Protopapadakis-Stoll (PS) [24] state that if markets are efficient and the ability to arbitrage exists, then the prices of a single asset, traded in two different markets expressed in a common currency, must be related as follows:

$$P = P^* \pi U \quad (1)$$

where P and P^* are the domestic and foreign price for the same asset; π is the relative exchange rate factor between domestic/foreign currency; and U is a random variable representing transportation costs. Analyzing prices of real assets,

requirement. Additionally, the minimum number of shares required to constitute a unit of trading also differs between the NYSE and TSE. See [9]. Also, the trading hours and operating days of the week differs for the TSE and for the NYSE. On the TSE, there are generally two trading sessions Monday through Friday and one morning session on each Saturday, except for the third Saturday of each month. Because daylight-savings time is observed seasonally on the NYSE and because of the 3 Saturday closings of the TSE each month, there is no entirely consistent difference in hours between the daily closing times on the two exchanges.

PS were concerned with the export-import point transportation costs represented by U . We will assume that financial assets (stocks) have very small, or zero, transportation costs associated with their trading; therefore, for the LOP to hold for our 17 dually listed stocks, we must have

$$P = P^* \pi \quad (2)$$

We will test the prices using this model, but will also test holding period returns. To test returns we take the natural log of (2) above and obtain

$$\rho = \rho^* + RE, \quad (3)$$

which implies

$$\rho - \rho^* = RE \quad (4)$$

Equations (3) and (4) simply state that if the LOP is valid, then the return on the security in the domestic market must be equal to the return on the security in the foreign market, plus any additional return which arises from changes in the relative exchange rates, RE .

Equations (2) and (4) will be tested, but we also wish to explore an additional test for segmentation. Specifically, we wish to determine if

$$\rho = f(\cdot) \equiv f^*(\cdot) = \rho^* + RE \quad (5)$$

where $f(\cdot)$ and $f^*(\cdot)$ represent functional sets of explanatory factors which determine returns in the domestic and foreign markets for a particular stock. If these functional sets are not equal for the same security traded in two different markets, then it would indicate that the two markets are not world-integrated, but that one or both are segmented.

The data consist of daily prices and dividends for the seventeen dually listed stocks which are traded on both the TSE and the NYSE over the period June 2, 1980 through October 31, 1983.⁵ These daily prices on both exchanges for each of the seventeen dually listed stocks are first formed into a set of matched pairs and then used in the test of equation (2) of spot prices. These daily prices with dividends per share added are also converted into matched pairs of holding period return vectors (that is, TSE versus NYSE).⁶ The first spot price and or holding

⁵ Daily dollar prices and dividends for the NYSE listed shares were obtained from the Center for Research into Security Prices at the University of Chicago. Daily yen prices and dividends for the TSE listed shares were obtained by personal correspondence. These are closing prices on both exchanges and are the only data during a trading day that is available. Much assistance for this research was provided by the New York and Tokyo offices of Daiwa Securities Research Institute, and Professor Takeshi Yamada of Hosei University, Tokyo.

⁶ The returns in each market are adjusted for dividends on the "ex-dividend" date. This is a normal practice in calculating holding period returns, but the international comparison of the dually listed stocks adds at least two significant problems. First, the international date line separates New York and Tokyo. Further, the TSE shares go ex dividend 4 full business days before the date of record, whereas the NYSE requires 5 full business days prior to the date of record. Therefore, the ex-dividend dates for

period return in each of these matched pairs is the price or return, including dividends, in the domestic market of primary location of the company. The second half of the matched pairs is the equivalent spot price or holding period return in the foreign market of secondary location. The holding period return of the stock in the primary market is matched against the return over an equivalent holding period in the secondary market. Since there may be infrequent trading in the secondary market, the secondary market defines the length of the holding period for both the secondary and primary market comparisons.⁷ Five separate minimum holding period lengths of one, seven, fourteen, twenty-eight, and fifty-six days are established for testing.

The study of these matched pairs of returns is begun after the proper "matching" of returns in the two markets was determined. Since the time of the closing prices is not identical in each market, various leads and lags of the matched pairs of holding period returns are employed to determine the best matching with

the same shares traded on the two exchanges are different. Second, the dividends are paid in the national currency of the corporation and any conversion to another currency will be made at the actual payment date, which is after the ex-dividend date. Therefore, the actual amount of the adjustment for the dividend payment is more complicated than is usually the case on the ex-dividend date.

The procedure employed in this paper is to adjust for dividends on the ex-dividend date in each of the specific markets. All TSE shares, both American and Japanese, will use the ex-dividend dates in Tokyo, and all NYSE shares will use the ex-dividend dates in New York. To aid understanding we call the NYSE the primary national market for American firms. The TSE is the secondary national market for these same dually listed shares. The actual amount of the dividend of a company on the secondary market (in local currency) is determined by adjusting the company's dividend in the primary market by the exchange rate on the secondary market's ex-dividend date. For example, Honda shares went ex-dividend 8/25/80 in New York and 8/27/80 in Tokyo. The first date will be used to determine the ex-dividend price on the NYSE and the second date will be used to determine the ex-dividend price on the TSE. Further the 5 yen dividend per share declared by Honda in Tokyo was converted to dollars using the yen/dollar exchange rate of 8/25/80 (i.e., the ex-dividend date on the NYSE). Because our adjustment for dividends was only one of many possible methods which could have been used, it may have introduced a disturbance into the calculation of the return data on ex-dividend dates. Therefore, all analyses were performed both with and without the inclusions of dividends. Since the conclusions of all analyses were shown not to be dependent upon the inclusion of dividends, we reported only those results where dividends have been included in the calculation of returns.

⁷ To provide a specific example for understanding, take the case of Citicorp. Citicorp is traded daily on the NYSE, the primary market, but was not traded every day on the TSE, the secondary market. Therefore, the first price and subsequent holding period return in the matched pairs was determined as the price and holding period return of Citicorp on the TSE. The first closing price for Citicorp traded on the TSE, after the beginning date of the study, was chosen as the beginning price and called P_0 . P_0 was 4,830 yen on June 9, 1980. The next closing price for Citicopr on the TSE after June 9, 1980, was selected as P_1 , and was 4,900 yen on June 11, 1980. The stock did not trade on Tuesday, June 10 on the TSE. The holding period return was then calculated as $[(P_1 + D_1 - P_0)/P_0]$ where D_1 represents any dividend paid during the holding period. Since there was no dividend paid between these dates, the holding period return for this period was .014492754. A similar procedure was used to calculate the equivalent holding period return in the primary national market (NYSE) for Citicorp. The second and all other sets of matched pairs of holding period returns for Citicorp were then determined in the same way. Generally, this procedure was required because the stocks in the secondary market were less frequently traded than in the primary market. Note that the length of the holding period will be the same for the returns of matched pairs, but that the holding period length of each matched pair might differ over time.

regards to “economic time.”⁸

After finding the best matching of the returns in terms of calendar leads and lags, the first test determines if there are statistically significant differences in the matched pairs of returns for the same security over the various holding periods. If these markets are integrated and the LOP holds, and if both markets are therefore responding to a similar set of economic information, then there should be no statistical differences between the matched pairs of returns.

In the second phase of the study, the pattern of differences in matched pairs of returns is compared against returns on the Japanese stock index, the United States stock index, the World stock index and the percentage change in the yen/dollar exchange rates.⁹ This test determines the primary underlying factors which help to explain the returns of the security in each market. If the underlying factors are the same for the two markets, for a given security, then this would be an indication of world-integration as opposed to market segmentation.

The final phase of the study is basically a macro-test of world-integration and uses cluster analysis to determine if the returns on the dually listed securities cluster differently. This clustering is first performed on the aggregate of all American and the aggregate of all Japanese firms, and then on each of the individual firms. If there is no discernable difference in the pattern of clustering, then this is yet another indication that the markets are world-integrated. That is, even though there are real differences between the characteristics of Japanese and American firms, their returns are still based on world-integrated factors.

II. RESULTS

A. Test of LOP with Prices

Equation (2) describes the relationship of the same financial asset traded in two different markets. The match prices of the ten American companies were first compared over the test period from June 2, 1980 through October 31, 1983. The yen prices of the ten American companies traded on the TSE on a specific date were converted into dollar prices using the daily exchange rate and then subtracted from the dollar price of the same firm on the NYSE. These sets of differences between matched prices in a common currency for each company were then analyzed. The average differences ranged from $-\$0.74$ for Chase Manhattan to $-\$0.11$ for General Motors. The dollar prices of the seven Japanese companies

⁸ Economic time is used here to describe the time period that a single piece of new information is acted upon in the two markets. This may be different from calendar time. Time matching and the resolution of this problem will be discussed at length in Section II.

⁹ In order to reduce the introduction of bias, we have chosen to select all the indexes and the exchange rates from the same source. Capital International S. A. Geneva, is recognized throughout the world for publication of the *Capital International Perspective*. Daily returns indexes were obtained from Capital International on the performance of the stocks on the United States, the Japanese, and on all the major stock markets of the world, called the World Index. The daily yen/dollar exchange rates also were obtained from this same source.

traded on the NYSE were converted to yen prices and matched against the yen price of these same companies on the TSE over the test period. The average company differences ranged from -37 yen for Pioneer to $+45$ yen for TDK. None of the seventeen individual company differences were significantly different from zero.¹⁰ Thus, the LOP appears to be valid when applied to the matched prices in a common currency of these seventeen dually listed companies over the test period. Yet, because the converted prices were not perfectly correlated among these matched pairs of dually listed companies, the return over various time periods may be more volatile than the prices; therefore, it is important to test the LOP using matched pairs of returns over various holding periods for these dually listed stocks.

B. Test of the LOP with Returns

In order to test the differences in returns with various holding periods the first requirement is to solve the problem of calendar time versus economic time period matching of returns. As stated previously, the NYSE and TSE are never in operation at the same point in real time. To examine matched pairs of returns for the dually listed stocks traded in these two markets, this nonsynchronous trading time must be addressed. To solve this problem we began with the *a priori* belief that the matching of holding period returns should be based on some rational conception of “economic” time, not on some “calendar” time construction that involves an arbitrary delineation of an international date line. Further, we feel that the most important factors determining a security’s worth and return would first be recognized by the investors in the primary market.¹¹ This means that the major factors affecting the holding period returns of American companies should first be recognized in the American marketplace and influence the returns on the NYSE. In turn, these factors would then influence the returns for the same American company on the TSE. The reverse would be true for those Japanese firms listed on the NYSE.¹²

¹⁰ Additionally, the correlations of the matched pairs of prices of each of the companies in the currency of the parent company were very highly correlated. The range of correlations ranged from .946 to .986 for American companies with an aggregate correlation of greater than .99. The matched prices of the Japanese companies denominated in yen also had a very high aggregate correlation greater than .99.

¹¹ Our data show that shares in the primary market have more frequent trades and higher volume than the same shares in the secondary market. In addition, it is easy to believe that specific companies will be followed by more security analysts in their primary market than in their secondary market.

¹² To illustrate this point better, consider the closing NYSE price for an American company, IBM for example, on June 13. Because of the difference in calendar time, the next possible closing price for IBM on the TSE occurs on June 14. The closing price on the next calendar day is the closest “economic” time for American companies traded on the TSE. Therefore, the returns on the TSE for all American companies are lagged one day in order to have the best economic match with the returns on the NYSE for the same company. On the other hand, the best “economic” time match for the closing price for a Japanese company on the TSE on June 13 is the closing price for the same calendar day on the NYSE. This occurs because the closing of the TSE on June 13 will precede the opening of the

To test this hypothesis of matching “economic” times, holding period returns on the NYSE for the seventeen dually listed companies were correlated against the equivalent holding period returns on the TSE; first with no lag (that is, using calendar time matching), and second with a one-calendar-day lag. The correlation coefficients between the TSE and NYSE returns, for all possible combinations of one-day lags using five different investment holding period horizons are shown in Table 1. The results confirm our hypothesis that major factors in the primary market appear to produce the best “economic” time matching of holding period returns for dually listed stocks. The returns on the NYSE, for the ten American companies, have a higher correlation for each holding period when the returns on the TSE have been lagged one calendar day. On the other hand, the returns on the NYSE, for the seven Japanese companies, have a higher correlation for each holding period when the returns on the TSE have not been lagged in calendar time.¹³

Also notice that the correlations between the NYSE and TSE returns, for both the American and Japanese firms, increase as the length of the holding period lengthens. One would expect this relationship since any operating time differential would have less total impact as the length of the holding period increases. Finally, since an “economic” matching approach has been supported by the results of a correlation study, all subsequent tests will maintain these economically matched relationships.

C. Average Returns of Major Variables

Mean returns as well as significance levels were calculated for specific measures of matched returns in local currency over the study period and are reported in Table 2. Since the returns were generally similar for the individual American and Japanese companies, the results are reported for these two groups as aggregates. Specifically, Table 2 contains the average holding period returns for those stocks traded on the TSE, for those stocks traded on the NYSE, and for those stock market indexes obtained from Capital International entitled: JAPAN, USA, and

NYSE on June 13. Thus, for returns of Japanese firms, using the same calendar time on the TSE and NYSE provides the best economic match. To summarize, the returns for Japanese companies on the TSE are matched in calendar time with the returns for the same Japanese firms on the NYSE, whereas the returns for American companies on the TSE are lagged one calendar day to be matched against their returns on the NYSE.

¹³ The correlation coefficients reported in Table 1 which show the proper information/time relationship are quite different from the leads and lags provided by Jaffe-Westerfield [12] (JW), but these differences are easily explained. First, and most importantly, the correlations in Table 1 are for the same assets and are therefore related to the same fundamental information, whereas the coefficients reported by JW are on indexes of different securities (S & P 500 versus Nikkei-Dow and TSE index). Second, because the returns correlated in Table 1 are based on the same financial asset, it is more likely that they will be related in some time dependent way to changes in information, whereas there are few *a priori* reasons to believe that indexes of different stocks in Japan and the U.S. would be related in any time dependent way. Finally, the correlations in Table 1 are highly significant, whereas those of JW are quite low and may not be statistically different from each other.

TABLE 1. CORRELATION COEFFICIENTS BETWEEN THE MATCHED HOLDING PERIOD RETURNS OF DUALY LISTED STOCKS ON THE NYSE AND TSE, WHERE THE RETURNS OF THE TSE STOCKS ARE EITHER LAGGED OR NOT LAGGED

Ten American Companies					
Holding period (days)	1	7	14	28	56
Not lagged	.43790	.68899	.80949	.84298	.90718
Lagged	.76246	.81881	.83724	.86289	.91656
Japanese Companies					
Holding period (days)	1	7	14	28	56
Not lagged	.67566	.87829	.90265	.90237	.94662
Lagged	.41789	.78907	.84878	.87928	.93351

the WORLD. In addition, the returns arising from changes in the relative exchange rates between the yen/dollar (Y/D) are also reported.¹⁴ Finally, the difference between the holding period returns calculated for each company on the TSE and the NYSE (TSE minus NYSE) are reported in aggregate for each of the five periods. For example, for those American companies with a specified minimum holding period of 1 day, the average holding period was actually 4.01 days over 2,968 observations of returns. This result was obtained because the American companies were infrequently traded on the TSE and only actual trades were used. Also notice that the Japanese companies have an actual average holding period much closer to the specified minimum in each category. This result is because the Japanese companies were traded more frequently on the NYSE than the American companies were traded on the TSE.

There are several other results found in Table 2 that are noteworthy. The first is that all of the various categories of returns, except for the changes in the yen/dollar exchange rate and the difference between the returns on the TSE minus the NYSE, are positive, significantly different from zero, and become larger as the holding period increases. However, the fact that the changes in the yen/dollar exchange rate, with one exception, were insignificantly different from zero is not surprising. One would not expect consistent positive (negative) returns from changes in the

¹⁴ Remember that the holding period length is established by the secondary national market for a particular stock. Therefore, the average returns reported in Table 2 for the JAPAN, USA, and WORLD as well as the Yen/Dollar exchange rate have different matched holding period lengths for American versus Japanese firms. This difference in holding period length is why the average values for JAPAN, USA, and WORLD, and Y/D are not identical. Further, the JAPAN and USA index values are denominated in their local currency. The WORLD index, on the other hand, is in dollars. Therefore, the holding period returns listed as JAPAN and as USA have not been adjusted for currency movements, whereas the WORLD index includes currency movements relative to the dollar.

TABLE 2. MEAN VALUES FOR IMPORTANT VARIABLES

American Companies					
Holding period (days)	1	7	14	28	56
Returns (TSE)	.002697*	.006797*	.011282*	.020383*	.042088*
Returns (NYSE)	.002271*	.005900*	.009800*	.017474*	.034160*
Returns (JAPAN)	.001510*	.004108*	.006906*	.012597*	.021179*
Returns (USA)	.001362*	.003780*	.006330*	.011484*	.021179*
Returns (WORLD)	.000910*	.002536*	.004259*	.007759*	.013966*
Returns (Y/D)	.000307	.000888	.001507	.002643	.007039*
TSE minus NYSE	.000426	.000898	.001482	.002909	.007928*
Number of days	4.01	10.90	18.24	32.45	60.94
Number of observations	2,968	1,089	650	364	190
Japanese Companies					
Holding period (days)	1	7	14	28	56
Returns (TSE)	.001287*	.005426*	.010870*	.021690*	.045027*
Returns (NYSE)	.001215*	.005430*	.010710*	.021233*	.043380*
Returns (JAPAN)	.000627*	.002756*	.005470*	.011099*	.021994*
Returns (USA)	.000641*	.003056*	.005934*	.011717*	.023852*
Returns (WORLD)	.000469*	.002248*	.004390*	.008700*	.017480*
Returns (Y/D)	.000050	.000188	.000492	.000890	.002348
TSE minus NYSE	.000072	-.000004	.000160	.000456	.001647
Number of days	1.62	7.27	14.25	28.34	56.24
Number of observations	4,490	997	507	255	127

* Significant at .05 level (two-tailed test).

yen/dollar exchange rate over time.

Perhaps the most important result in terms of the question of market segmentation is that the difference between the holding period returns on the TSE and the NYSE, with one exception, are not significantly different from zero. This evidence suggests that the LOP holds and that the dually listed stocks are reacting to international or integrated factors, rather than to local or segmented factors. Only at the longest holding period in the study are there opportunities to earn a significant non-zero return by purchasing the ten American firms on the TSE versus those same ten firms on the NYSE. However, this non-zero difference appears to be closely related to the returns arising from changes in the yen/dollar exchange rate, which also is significant for this same holding period. In fact, for the American firms, there appears to be almost a one-to-one relationship between the differences of the returns in the two markets and the returns arising from the changes in the relative exchange rates (Y/D). This result is exactly what one would

expect from Equation (4) if the LOP holds. The same relationship for the Japanese companies is much less exact, and indicates that for these firms Equation (5) may not hold. This possibility is examined in more detail in the next section.

D. An Examination of the Differences Between the TSE and NYSE Returns

The average differences between the returns on the TSE and NYSE are not, with one exception, significantly different from zero. For the American companies, those differences that do exist seem to correspond to exchange rate returns. However, this degree of correspondence is not as great for the Japanese firms. One possible explanation for this is that security-specific segmentation exists. That is, the returns on dually listed Japanese firms may be responding to underlying factors that differ between the two markets, whereas the dually listed American firms are not. To test this possibility, step-wise regressions were run, where the dependent variables were the differences between the returns on the TSE and the NYSE. The independent variables employed were the returns over the same holding periods on the JAPAN index, the USA index, and the WORLD index, and the percentage change in the Yen/Dollar exchange rate. In all cases but one, the percentage change in the exchange rate was the first explanatory variable to enter the regression.

The second variable to enter the step-wise regression was different for the American and the Japanese firms. In general, the second most important variable in explaining the differences in returns for Japanese companies on both the NYSE and TSE exchanges was the returns on the JAPAN index. For the differences in returns of the American companies on the two exchanges, the returns on the USA index was the second most important variable.

Table 3 provides support for the results of the step-wise regression analysis. Section A shows that the differences in returns between the TSE and NYSE (T-NY) has the highest single-variable correlation with the returns arising from changes in the relative exchange rates (Y/D). In fact, these correlations reach a high of .90006 for American companies and the 56 day holding period. Again, this is consistent, given Equation (4), with what we would expect if the LOP holds. Table 3 also provides support for the LOP in terms of the relationship specified by Equation (5). According to this equation, returns in the two markets should respond to the same underlying factors, and this is exactly what is observed.

For American companies, the returns calculated on either the TSE or NYSE have the highest correlation with the returns on the USA index over all holding periods. For the Japanese companies, the calculated returns on both the TSE and the NYSE have the highest correlation with the JAPAN index. Further, the next highest correlation for *both* the American and Japanese companies, and for *both* exchanges, is the WORLD index. The WORLD index always has a higher correlation than the JAPAN index for American companies. For Japanese companies, the WORLD index, even though it is composed of a high proportion of American companies, also has a higher correlation than the USA index. The

TABLE 3. CORRELATION COEFFICIENTS BETWEEN VARIOUS RETURNS

American Companies					
Holding period (days)	1	7	14	28	56
A. T-NY vs. JAPAN	-.16518	-.23339	-.24173	-.14287	-.13770
T-NY vs. USA	-.11435	-.16471	-.18442	-.08258	-.34057
T-NY vs. WORLD	-.23104	-.31199	-.34198	-.26290	-.34057
T-NY vs. Y/D	.40920	.56515	.61250	.63521	.90006
B. TSE vs. JAPAN	.06418	.11958	.10458	.12493	.16396
TSE vs. USA	.41610	.42723	.43226	.43240	.47154
TSE vs. WORLD	.29458	.30992	.31186	.31502	.34194
TSE vs. Y/D	.11950	.14120	.14058	.23852	.33110
C. NYSE vs. JAPAN	.19024	.26527	.24552	.29014	.23273
NYSE vs. USA	.53815	.53919	.54500	.50106	.54643
NYSE vs. WORLD	.49008	.50868	.51335	.47469	.50808
NYSE vs. Y/D	-.16363	-.20008	-.20952	-.09179	-.03137
Japanese Companies					
Holding period (days)	1	7	14	28	56
A. T-NY vs. JAPAN	.13782	-.13232	-.21816	-.18569	-.09016
T-NY vs. USA	-.27120	-.21065	-.22891	-.13156	-.25732
T-NY vs. WORLD	-.23104	-.31199	-.34198	-.26290	-.34057
T-NY vs. Y/D	.19934	.50679	.69495	.75955	.83299
B. TSE vs. JAPAN	.61169	.60496	.60244	.59353	.60766
TSE vs. USA	.05827	.24113	.28427	.27745	.22450
TSE vs. WORLD	.24644	.34683	.33900	.34114	.30952
TSE vs. Y/D	.14600	-.16246	-.05333	-.01497	.03470
C. NYSE vs. JAPAN	.48580	.61463	.65479	.64149	.62453
NYSE vs. USA	.27261	.32067	.36330	.31925	.30332
NYSE vs. WORLD	.40660	.45331	.48152	.46364	.42546
NYSE vs. Y/D	-.30098	-.39092	-.34935	-.34310	.23593

presence of this relationship is a clear indication that returns on the dually listed securities react primarily to factors in their primary market, but that both markets are strongly integrated in a world context. If one or both of these markets were truly segmented, then one would expect that the returns on securities within the segmented market, regardless of whether analyzing an American or a Japanese company, should react primarily to factors that affect that market. Since this is not the case, we have further evidence that the LOP holds and the markets are not segmented.

E. Cluster Analysis

As a final test of segmentation versus integration, several types of cluster analyses were performed. Cluster analysis allows the grouping of observations into sets that demonstrate similar characteristics. Cluster analyses were performed on three variables: (1) returns on the TSE, (2) returns on the NYSE, and (3) the differences between the returns on the TSE and the NYSE. It is hypothesized that if segmentation exists on a macro scale, due to differences in the characteristics between Japanese and American firms, then the return observations of the Japanese companies should all be assigned to one cluster, while the returns for the American companies should be assigned to an alternative cluster.

The cluster analysis for the three variables are found in Table 4, which provides the percentage of total return observations in each cluster, for various holding periods, for the aggregate of the American and Japanese firms. The data illustrate that the clustering patterns for the American and Japanese firms are similar. For example, when observations are clustered in terms of the holding period returns on the TSE (Section A of Table 4), the percentages in the two clusters are similar for both the Japanese and American firms. If capital markets were segmented on a

TABLE 4. CLUSTER ANALYSIS FOR THE AGGREGATE OF AMERICAN AND JAPANESE FIRMS
(percentage of total in each cluster)

A. Variable: Returns (TSE)											
Holding period (days)	1		7		14		28		56		
	A	B	A	B	A	B	A	B	A	B	
American	18%	82%	49%	51%	50%	50%	38%	62%	31%	69%	
Japanese	13	87	43	57	45	55	39	61	32	68	

B. Variable: Returns (NYSE)											
Holding period (days)	1		7		14		28		56		
	A	B	A	B	A	B	A	B	A	B	
American	35%	65%	50%	50%	31%	69%	35%	65%	29%	71%	
Japanese	38	62	48	52	38	62	39	61	32	68	

C. Variable: Returns (TSE-NYSE)											
Holding period (days)	1		7		14		28		56		
	A	B	A	B	A	B	A	B	A	B	
American	23%	77%	37%	63%	44%	56%	35%	65%	32%	68%	
Japanese	24	76	33	67	47	53	36	64	31	69	

macro-scale due to differential firm characteristics, then one would expect all American observations to be assigned to one cluster and all Japanese observations to be assigned to the other cluster. These results were not observed for any of the three different measures of returns.

These results indicate that there is no segmentation of American versus Japanese firms in terms of their returns on the TSE, the NYSE, or the differences between the returns for companies on the two exchanges. This similarity of clustering patterns for returns is somewhat surprising, since the Japanese and American companies differ in many "industrial" respects, and one might expect their returns to differ significantly from each other. However, it might be argued that what is really happening, since Table 4 presents the results only for the aggregate groupings, is that all of the observations for some of the companies (both American and Japanese with similar industrial characteristics) are being assigned to one cluster while all other observations are assigned to the other cluster. To demonstrate that this is not the case, a cluster analysis was performed on each individual company. The variable which is presented here for this cluster analysis is the difference in returns on the TSE and the NYSE.

TABLE 5. CLUSTER ANALYSIS FOR INDIVIDUAL COMPANIES: DIFFERENCES BETWEEN RETURNS ON THE TSE AND THE NYSE FOR THE SAME COMPANY
(Percentage of total in each cluster)

Holding period (days) Clusters	1		7		14		28		56	
	A	B	A	B	A	B	A	B	A	B
American Companies:										
Bank of Amer.	32%	68%	46%	54%	46%	54%	42%	58%	33%	67%
Chase Manhat.	23	77	34	66	48	52	45	55	33	67
CitCorp	21	79	37	63	41	59	36	64	25	75
Down Chem.	29	71	37	63	53	47	31	69	42	58
1st Chicago	30	70	38	62	39	61	32	68	21	79
Gen. Motors	21	79	37	63	44	56	34	66	23	67
I U IntNatl.	23	77	36	64	45	55	37	63	29	71
I.B.M.	16	84	33	67	44	56	32	68	36	64
I.T.T.	24	76	39	61	43	57	21	79	33	67
Sperry	33	67	31	69	42	58	42	58	35	65
Japanese Companies:										
Hitachi	19	81	33	67	51	49	40	60	40	60
Honda	19	81	32	68	46	54	34	66	32	68
Kyocera	20	80	27	73	47	53	35	65	32	68
Matsushita	24	76	31	69	45	55	34	66	23	77
Pioneer	27	73	40	60	49	51	35	65	33	67
Sony	31	69	39	61	46	54	41	59	32	68
T.D.K.	23	77	29	71	51	49	35	65	37	63

The data in Table 5, like Table 4, also provides the percentages of total observations for each of the two clusters and for each of the five holding periods, but now for each of the seventeen companies instead of in aggregate. The results indicate that no company has observations assigned to only one particular cluster. In fact, the pattern of the percentages, within each of the five holding periods aggregate groupings, is that all of the observations for some of the companies analyzed, is remarkably similar for both the American and the Japanese companies. These results are a further indication that, at least on a macro-scale, the dually listed security returns analyzed in this study are world-integrated, not segmented.

IV. SUMMARY

There are major cultural and other economic differences between Japanese and American capital markets. It has often been argued that many Japanese markets, unlike American markets, are segmented and do not respond to changes in world-economic factors in an integrated fashion. The purpose of this paper is to determine if the apparent Japanese restrictions and cultural differences are significant enough to cause the market for equity securities in Japan to be segmented, and therefore to violate the Law of One Price (LOP), or whether they exhibit full integration. In addition to testing whether the LOP holds for dually listed securities, both in terms of price and returns, the paper also tests whether the underlying explanatory factors or the return generating process differs between the Japanese and American capital markets, and whether there is a macro-difference in returns due to difference in the characteristics of Japanese and American firms.

The data employed are the spot prices and realized holding period returns for seventeen stocks which are dually listed on the TSE and the NYSE. These data and the particular methodologies employed are unique, as most previous research on international equity market integration only analyzed the differences in market indexes. Since market indexes, or portfolios, employed in prior studies do not include the same stocks and differ in perceived risk and expectations of return, and since these studies have great difficulty controlling for comparative risks, their results are subject to a wide range of interpretations. On the other hand, our data set of dually listed stocks represents equivalent ownership in the *same* underlying assets and, thus, risk is the same in both markets. Therefore, the use of these prices and realized returns allow superior tests of the segmentation versus integration of the markets. Further, since any Japanese cultural or economic restrictions would apply equally to all securities traded on the TSE, the results of this study of comovements of these seventeen stocks provides evidence on the segmentation versus integration of the TSE marketplace.

The findings of this study are as follows:

1. The matched prices in a common currency of each of the seventeen dually listed stocks over the time period were very highly correlated and their differences

in price were statistically insignificantly different from zero. This indicates that the law of one price is not violated.

2. The returns of all seventeen companies on both exchanges were positive, significantly different from zero, and increased directly with the length of the holding period. The difference between the matched holding period returns of the same shares on the two markets generally were not significantly different from zero. Thus, there is a high degree of similarity between the two sets of returns over the five holding periods studied. The results indicated that the LOP is not violated, and thus suggests the world-integration as opposed to segmentation of the two markets.

3. The most significant variable in explaining the differences in the returns for the same stock on the two exchanges was the percentage change in the exchange rate. This result is to be expected if the LOP is valid. The second most important variable was the returns in the primary market for each of the particular firms. If the markets were segmented, the returns of both the Japanese and American companies traded on the TSE should be primarily affected by movements in the Japanese capital market. Since this relationship was not found, the results indicate the integration, rather than the segmentation, of the Japanese market.

4. A cluster analysis of the dually listed returns on the TSE, the NYSE, and the difference in returns between the TSE and the NYSE, showed no significant differences in the clustering patterns between the American and the Japanese companies or for each of the dually listed firms. These results indicate that there is no segmentation, at least on a macro-scale, due to differences in the characteristics between Japanese and American firms.

There are major differences between the Japanese and American capital markets, such as: taxation, requirements for foreign purchasers, investor attitudes toward savings and equity investments, and the protective nature and actions of government officials. However, even with all the apparent cultural, institutional and regulatory restrictions, the results of our analysis indicate that the prices and returns for stocks dually listed on the Tokyo and the New York Stock Exchanges exhibit patterns of returns which are well integrated in terms of world market conditions, and which are not indicative of segmented markets. Thus, it is concluded that the Tokyo Stock Exchange is not a segmented market.

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