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Abstract: This paper examines a unique data set consisting of Japanese equity returns for the Friday, Monday, and Tuesday surrounding U.S. Monday holiday closures. The objective is to neutralize the impact of spillover effects from New York to Tokyo. Prior studies find that Japanese returns are negative on Tuesday and anomalous; this phenomenon is known as the Japanese-Tuesday effect. One explanation for the Japanese-Tuesday effect is that there exists a cause and effect relationship with Monday returns in New York. Historically, Monday returns in New York are negative, a phenomenon known as the U.S.-Monday effect. The empirical results show that U.S. Monday closures have a significant impact on Japanese return dynamics for surrounding trading days. The empirical evidence does not support the hypothesis that the U.S.-Monday and Japanese-Tuesday effects are related. Potential explanations for the occurrence and then disappearance of the Japanese-Tuesday effect rely on microstructure properties unique to Tokyo. More recently, spillover effects from New York to Tokyo have increased in intensity, and this is attributed to the introduction of the Nikkei 225 index on the SIMEX.

JEL classification: F30, G14

Key words: spillover effects, Japanese-Tuesday effect, market efficiency

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An Analysis of Japanese Stock Return Dynamics Conditional on U.S. Monday Holiday Closures

I. Introduction

Stock markets in the United States (U.S.) and Japan are of special interest to researchers for numerous reasons. Foremost, the New York and Tokyo stock exchanges currently rank first and second, respectively in the world in terms of market capitalization and both the U.S. and Japan are well linked economically and financially through international trade and investments. A number of studies examine cross-border market linkages using U.S. and Japanese stock return data and significant return correlations are documented. This research includes studies by Karoyli and Stulz (1996), Booth, Lee and Tse (1996), Bae and Karolyi (1994), Becker, Finnerty and Gupta (1990), Hamao, Masulis, and Ng (1990), and Barclay, Litzenberger and Warner (1990). A research finding is that New York is the dominant world security market with Tokyo closely integrated with New York. In this paper, the term spillover effects refers to the empirical observation that returns in New York impact next day returns in Tokyo and vice versa.

French (1980) examines U.S. return data and finds that Monday's mean return is negative and significantly different from other days of the week. This much-researched phenomenon is known as the U.S.-Monday effect.[1] International financial market integration suggests that U.S. day-of-the-week return patterns transcend international boundaries. As an extension of prior research, Kato (1990) and Ziemba (1991) examine Japanese return data from April 1978 through June 1987 but find nothing unusual about Monday's mean return. However, both authors report that Tuesday's mean return is negative and statistically different from other days of the week and label this

phenomenon the Japanese-Tuesday effect. Tuesday-Tokyo trading follows Monday-New York trading with a lag of three hours, and based on this fact, Kato hypothesizes that there is a cause and effect relationship between the U.S.-Monday and Japanese-Tuesday effects.[2]

Tokyo is thirteen hours ahead of New York, and trading sessions do not overlap. Based on this fact, international asset pricing models predict spillover effects from New York to Tokyo exclusively in overnight returns (e.g., Stulz (1981), Solnik (1983), Cho, Eun and Senbet (1986)). Spillover effects in trading-period returns violate the efficient markets paradigm. If a cause and effect relationship exists between the U.S.-Monday and Japanese-Tuesday effects, then theory predicts that the Japanese-Tuesday effect is a nontrading-period effect (the negative returns accrue over the Monday close to Tuesday open period in Tokyo).

Puffer (1991) examines the impact of intermittent Saturday trading in Tokyo on return dynamics in New York.[3] The variance of New York stock returns measured from Friday's close to Monday's open is more than three times higher when Saturday trading occurs in Japan versus when there is no Saturday trading. Puffer argues that this result suggests that private information revealed through trading in Japan has a global component. Since New York is the world's dominant security market, private information revealed through trading in New York conceptually has a global component as well. This paper takes advantage of frequent Monday holiday closures in New York to examine how U.S. market closures affect Japanese return dynamics. Whenever, Monday-New York trading is suspended, Monday's trading halt severs the normal flow of information from New York to Tokyo. Participation by foreign investors is reduced,

and this could impact liquidity, trading volume and returns in Tokyo on the Friday, Monday and Tuesday surrounding the U.S. holiday closure.

An objective of this study is to examine the impact of U.S. Monday holiday closures on Japanese return dynamics for the surrounding Friday, Monday, and Tuesday. This study's methodology provides insight into potential causes of the Japanese-Tuesday effect by examining Tuesday's return pattern in Tokyo following U.S. Monday holiday closures. Nikkei (NK) 225 index futures commenced trading on the Singapore International Monetary Exchange (SIMEX) on September 3, 1986, and the impact of this event on the linkage from New York to Tokyo is examined.

We find that U.S. Monday holiday closures have a significant impact on Japanese return dynamics for the surrounding Friday, Monday, and Tuesday. However, the empirical evidence does not support the hypothesis that the U.S.-Monday and Japanese-Tuesday effects are related. Potential explanations for the occurrence of the Japanese-Tuesday effect and its recent disappearance are presented, and these explanations rely on microstructure properties unique to Tokyo. More interestingly, spillover effects from New York to Tokyo have become more pronounced recently, and this is attributed to the introduction in 1986 of Nikkei 225 futures on the SIMEX and the new strong dominance of the U.S. stock market in the world during the 1990's.

The rest of this paper is organized in the following manner. Sections II and III contain a discussion of the data set and research methodology, respectively. Section IV presents and discusses the empirical findings, and a summary and conclusions follow in Section V.

II. Data

Japanese equity returns are examined for a unique subset of trading days, the Friday, Monday and Tuesday surrounding U.S. Monday holiday closures. Whenever Monday trading is suspended in the U.S., the international security market linkage from New York to Tokyo is temporarily disrupted and at least conceptually, Tuesday trading in Tokyo is more independent of New York.

The data consists of daily opening and closing prices for the Tokyo Stock Exchange Price Index (TOPIX) over the period January 1, 1976 through December 31, 1996. Daily returns are decomposed into close-open (nontrading period) returns and open-close (trading period) returns using opening price data obtained from various issues of the *Shoken Shimbun* (Japanese Securities Market Newspaper). The TOPIX does not have a well-defined opening price so that the reported 9:15 a.m. value of the index is used as a proxy for the opening price. The 9:15 a.m. value is measured 15 minutes after the theoretical opening, and this helps to mitigate the potential nonsynchronous measurement problem discussed by Becker, Finnerty and Tucker (1992).

The data set is divided into two subperiods based on the existence versus non-existence of NK 225 futures in order to isolate the impact of futures trading on Japanese stock return dynamics. The first subperiod covers the eleven-year period 1976 through 1986 and reflects the absence of index futures trading. The second subperiod covers the ten-year period 1987 through 1996 and reflects the possible impact of index futures trading. For expository purposes, the cut-off date for the first subperiod is December 31, 1986 and not September 2, 1986, but both dates yield similar empirical results.

III. Methodology

The Tokyo Stock Exchange (TSE) is the first major market to begin trading each day as well as each week. The weekend closure of all world security markets reduces Monday's trading volume and liquidity in Tokyo. Relative to other days-of-the-week, Monday's trading volume for the first section of the TSE for the period 1976 through 1996 is actually seventeen percent lower. In Tokyo, this phenomenon is more pronounced whenever U.S. Monday trading is suspended due to a holiday closure.

Monday holiday closures in New York are selected as a control variable to isolate spillover effects from New York to Tokyo for one important reason. Over 50 percent of U.S. holiday closures occur on a Monday, and thus a sufficiently large number of observations are generated. If Monday trading is suspended in New York, then the international security market linkage from New York to Tokyo is temporarily disrupted. Not only is the production of both public and private information in New York reduced on the Friday, Saturday and Sunday preceding a U.S. Monday holiday closure, but also information endemic to New York now accumulates over a longer nontrading interval before it is reflected in Tokyo trading on Wednesday. If the primary direction of influence is from New York to Tokyo, then one way to test for the strength of this linkage is to examine the impact of temporary trading breaks in New York on the Japanese equity market. In particular, if cross-market linkages from the U.S. to Japan are weak, then trading disruptions in New York will have little or no impact on Japanese return dynamics. The disruption of market linkages from the U.S. to Japan due to a U.S. Monday holiday closure increases the risk of Monday and Tuesday mispricing in Japanese security markets. With heightened risk and reduced liquidity, discretionary

liquidity and informed traders both have an incentive to shift some of their trades temporarily to surrounding days.

The model developed and tested in Section IV incorporates a number of factors identified as impacting Japanese return dynamics. These factors include intermittent Saturday trading in Japan prior to February 1989, the Golden Week holiday period and day-of-the-week (DOW) effects. Golden Week consists of three holidays over the period April 28 through May 6, and most Japanese take extended trips during the Golden Week period. Hiraki and Maberly (1995) find that returns are unusually large throughout the Golden Week Period on pre-holidays, post-holidays and days in between.

To study the impact of U.S. Monday holiday closures on Japanese share prices, a robust regression methodology is used with lagged decomposition of daily returns. DOW effects are introduced into equation (1) using dummy variables for Monday, Tuesday and Friday. A constant term jointly with the lag return effect captures the return dynamics for Wednesday, Thursday and Saturday, and henceforth referred to as all other days. Variations in the Monday, Tuesday and Friday DOW effects are introduced for U.S. Monday holiday closures and Saturday trading.

The estimated model is given by:

$$R_t = \beta_0 + \beta_1 M_t + \beta_2 T_t + \beta_3 F_t + \beta_4 M_{st} + \beta_5 T_{st} + \beta_6 F_{st} + \beta_7 M_{Ht} + \beta_8 T_{Ht} + \beta_9 F_{Ht} + \beta_{10} G_t + \Sigma_i [\gamma_{i1} RCO_{t-i} + \gamma_{i2} ROC_{t-i}] + \varepsilon_t \qquad (1)$$

In equation (1), R_t is the measured return on day t defined as the logarithm of the price relative, and R_t can be close-close, close-open or open-close return series. RCO and ROC represent decomposed close-open and open-close returns, respectively. When the dependent variable is open-close return, one should advance lagged close-open returns by

one, and therefore the first lag is RCO_{t-0} rather than RCO_{t-1}. The reason is that overnight returns on day t represent the return from the prior day's closing to the current day's opening price. To capture the short-term dynamics of the return generating process, three lags are incorporated into equation (1) for each return series examined.[4] A more appropriate structure for intraday and daily returns is the use of the most recent intraday lagged returns in which some mild but significant correlation is expected due to various market microstructure or information reasons.

In equation (1), the variables M_t, T_t and F_t represent dummy variables for Monday, Tuesday and Friday, respectively. A Monday following Saturday trading, indicated by M_{st}, has an average return $\beta_o+\beta_1+\beta_4$ with β_4 measuring the difference between returns for Monday following Saturday trading and a normal Monday before adjusting for the effect of lagged returns. M_{Ht} represents a Monday preceding a U.S. Monday holiday closure. Thus, $\beta_o+\beta_1+\beta_7$ represents the average return for such a Monday with β_7 measuring the differences from a normal Monday before adjusting for the effect of lagged returns. The coefficients for Tuesday- and Friday-related dummy variables are constructed and interpreted in a similar fashion. The remaining variable G_t is a dummy variable capturing the effects of the Golden Week group of holidays but is defined broadly to include not only pre-holidays but also post-holidays and days in between as well. It is obvious that the β_0 coefficient represents the average return for Wednesday, Thursday and Saturday before adjusting for the effect of lagged returns.

The equation (1) coefficients are estimated using a scale invariant M-estimator proposed by Huber (1964). An M-estimator reduces the potential impact of outliers on parameter estimates by constructing the tails of the distribution inward. Gallant (1987)

proposes a method of moments procedure to simultaneously estimate the model parameters of interest and the scale factor used to modify the distribution. Gallant uses the natural log of the hyperbolic cosine function, cosh(.5u) where $u = \varepsilon/s$ represents the distribution of residuals (ε) normalized by the scale factor s. The moment equations are constructed by differentiating the function ln cosh(.5u) and integrating. Robust t-statistics are obtained with a spectral density kernel estimator of the covariance matrix with quadratic weights and analytical derivatives. Due to the dynamic relationships inherent in equation (1), the parameter estimates for close-close returns are not equal to, but are approximately equal to the sum of the parameter estimates for close-open and open-close returns.

IV. Empirical Results

A. Japanese Return Dynamics Conditional on U.S. Monday Holiday Closures

The empirical results are presented in Table 1, panel A, for the sample period 1976 through 1996. Panels B (1976 through 1986) and C (1987 through 1996) correspond to the pre- and post-NK 225 index futures period, respectively.

Golden Week and Saturday Trading

The impact of Golden Week on returns is represented by the β_{10} coefficient. Returns during the Golden Week period are unusually large, and this phenomenon is interpreted predominately as a trading period effect. These results justify including a Golden Week variable in equation (1). The impact of Saturday trading on the following Monday and Tuesday is captured by the β_4 and the β_5 coefficient, respectively. The β_6 coefficient measures the impact of Saturday trading on Friday's return. Some background information is needed before these results can be interpreted.

Saturday trading was eliminated on the TSE beginning February 1989, but in August 1986, Saturday trading was reduced from three to two Saturdays per month. Since less than ten percent of Saturday trading days occur over the second subperiod 1987 through 1996, the results reported for the first subperiod 1976 through 1986 are more important. The empirical evidence presented in Table 1, panel B, indicates that Saturday trading has no impact on observed returns for the following Monday and Tuesday with one minor exception (Saturday close to Monday open returns are larger than normal). The results for Friday are more interesting. Friday returns are larger than normal (the β_6 coefficient is positive and significant at the 0.01 level) whenever the week ends with Saturday trading, but this phenomenon is exclusively a trading period effect. The results reported for Friday are qualitatively consistent with Puffer's (1991) observation, focusing on the variance of returns, that Tokyo returns measured from Friday close to Monday open are very different between weeks ending with and without Saturday trading.

Friday, Monday and Tuesday Surrounding U.S. Monday Holiday Closures

F_{Ht} represents Fridays preceding U.S. Monday holiday closures. Thus, $\beta_0+\beta_3+\beta_9$ represent the average return for such a Friday with β_9 measuring the difference from a normal Friday. Friday TOPIX returns are unusually negative (the β_9 coefficient is negative and significant at the 0.01 level) for Fridays preceding a Monday holiday in New York, and this result holds over both subperiods.

In contrast, over the first subperiod (1976 through 1986), there is nothing unusual about Monday and Tuesday returns surrounding U.S. Monday holiday closures (both coefficients β_7 and β_8 are numerically close to zero and insignificant), but the situation is

reversed over the second subperiod (1987 through 1996). For the second subperiod, Monday returns are higher than normal (the β_7 coefficient is positive and significant at the 0.01 level) and Tuesday returns are lower than normal (the β_8 coefficient is negative and significant at the 0.01 level) on those days surrounding U.S. Monday holiday closures. This pattern resembles the return pattern observed for normal Mondays and Tuesdays over the first subperiod.

In summary, Friday TOPIX returns are unusually negative conditional on the suspension of U.S. Monday trading due to a holiday closure, and this pattern is consistent across subperiods. Over the first subperiod, Monday and Tuesday TOPIX returns surrounding U.S. Monday holiday closures are not different from normal Mondays and Tuesdays. In contrast, over the second subperiod, Monday TOPIX returns are higher than normal and Tuesday TOPIX returns are lower than normal surrounding U.S. Monday holiday closures.

Bull versus Bear Market

From January 1, 1987 to December 31, 1989, the TOPIX increased by eighty-three percent, but by December 31, 1993, the TOPIX had declined by forty-five percent. Table 2, panels A and B, reports results for the subperiods 1987 through 1989 and 1990 through 1993. These two subperiods are unique in that 1987 through 1989 corresponds to a bull-market period in Tokyo and 1990 through 1993 to a bear-market period. Other things being equal, there should be more evidence of selling pressure over the bear-market period (1990 through 1993), and any additional selling pressure is likely to manifest itself in Monday and Tuesday's return patterns.

Returns for a normal Monday and Tuesday are represented by $\beta_o+\beta_1$ and $\beta_o+\beta_2$, respectively. Somewhat surprisingly, the β_1 coefficient is negative and significant at the 0.01 level for both bull and bear markets, and the sum $\beta_o+\beta_1$ is negative in both instances. Thus, the Japanese-Monday effect is observed over both subperiods. Evidence of the Japanese-Monday effect over the bull-market period is surprising. Since the sum $\beta_o+\beta_2$ is positive for both bull and bear markets, there is no evidence of the Japanese-Tuesday effect for normal Tuesdays.

The Japanese return pattern for the Monday and Tuesday surrounding U.S. Monday holiday closures is more interesting. Conditional on a Monday holiday closure in New York, Monday's TOPIX returns are larger than normal (the β_7 coefficient is positive and significant at the 0.01 level), and the sum $\beta_o+\beta_1+\beta_7$ is positive for both bull and bear markets. Thus, in this instance, the Japanese-Monday effect disappears for both bull and bear markets. In contrast, conditional on a Monday holiday closure in New York, Tuesday's TOPIX returns over the bear-market period are lower than normal (the β_8 coefficient is negative and significant at the 0.01 level), and the sum $\beta_o+\beta_2+\beta_8$ is negative. A highly significant Japanese-Tuesday effect is observed over the bear-market period 1990 through 1993.[5] The selling pressure that was observed on normal Mondays shifts to Tuesdays whenever Tuesday follows a Monday holiday closure in New York.

In summary, conditional on a Monday holiday closure in New York, Monday and Tuesday's TOPIX return patterns for the bear-market period are consistent with arguments presented in this paper to explain causes of the Japanese-Tuesday effect, its subsequent disappearance, and the emergence of the Japanese-Monday effect.

B. Japanese-Tuesday Effect

Analysis of Tuesday Time Decomposed Returns

The first objective here is to verify the existence of the Japanese-Tuesday effect and to examine Tuesday's time decomposed returns. As noted previously, if world equity markets are efficient, then Tuesday's trading period TOPIX returns should be unaffected by information generated on Monday in New York. From equation (1), Tuesday's mean return, before adjusting for the effect of lagged returns, corresponds to $\beta_0+\beta_2$ with β_2 measuring the average difference in returns between Tuesday and all other days, and these results are reported in Table 1 for all three return measures and for all three different sample periods. For the 1976 through 1996 period, Tuesday's mean close-close return equals –0.0346 percent, and the β_2 coefficient is significant at the 0.01 level. Similar results are reported in panel B for the first subperiod 1976 through 1986 (Tuesday's mean close-close return equals –0.1030 percent). However, there is no evidence of the Japanese-Tuesday effect over the second subperiod 1987 through 1996 (Tuesday's mean close-close return equals 0.0295 percent and the β_2 coefficient is insignificant). An analysis of time decomposed returns shows that the Japanese-Tuesday effect is exclusively a trading period effect. For the 1976 through 1996 period, Tuesday's mean nontrading-period return is positive at 0.0351 percent, but its mean trading-period return is negative at –0.0802 percent. Similar results are reported in panel B for the first subperiod (Tuesday's mean nontrading- and trading-period returns are 0.0265 and –0.1460 percent, respectively).

In summary, the Japanese-Tuesday effect is exclusively a trading-period phenomenon, but the negative Tuesday returns are confined to the first subperiod 1976 through 1986. These findings are inconsistent with the predictions of international asset

pricing models and the hypothesis that the U.S.-Monday and Japanese-Tuesday effects are related.

U.S. Monday Holiday Closures and the Japanese-Tuesday Effect

This section examines Tuesday's TOPIX return pattern for those Tuesdays following U.S. Monday holiday closures. If the U.S.-Monday and Japanese-Tuesday effects are related, then in the absence of U.S. Monday trading, the Japanese-Tuesday effect should either disappear or at the very least the absolute value of Tuesday's mean return should decline.

Tuesday's mean return following U.S. Monday holiday closures is given by the value of $\beta_0+\beta_2+\beta_8$ with β_8 measuring the difference from a normal Tuesday. The positive β_8 coefficient is consistent with a less pronounced Japanese-Tuesday effect in the absence of U.S. Monday trading. As reported in Table 1, panel A, the β_8 coefficient associated with the 1976 through 1996 period is negative in sign and highly significant for all three return measures, and these results are inconsistent with the hypothesis that the U.S.-Monday and Japanese-Tuesday effects are related. For the 1976 through 1996 period, the value of $\beta_0+\beta_2+\beta_8$ equals –0.3001 with the β_8 coefficient equal to –0.2655. Since the mean return for a normal Tuesday equals –0.0346 percent, the Japanese-Tuesday effect is actually more pronounced over the 1976 through 1996 period for those Tuesdays following U.S. Monday holiday closures.

The empirical results for the first (1976 through 1986) and second (1987 through 1996) subperiods are reported in panels B and C, respectively. For the first subperiod 1976 through 1986, the β_8 coefficient is close to zero and not significant at a meaningful level for all three return measures examined, and this implies that there is no change in

the Japanese-Tuesday effect in the absence of U.S. Monday trading. For the second subperiod 1987 through 1996, the β_8 coefficient is negative in sign and highly significant for all three return measures examined. For example, the β_8 coefficient corresponding to close-close returns equals –0.3997, and this implies that the Japanese-Tuesday effect is more pronounced in the absence of U.S. Monday trading. Thus, a highly significant Japanese-Tuesday effect is documented over the second subperiod in the absence of U.S. Monday trading. This finding is interesting if not perplexing since the Japanese-Tuesday effect disappears for normal Tuesdays over the second subperiod.

In summary, the Japanese-Tuesday effect does not disappear in the absence of U.S. Monday trading but actually increases in intensity. The results reported in Table 1 do not support the hypothesis that the U.S.-Monday and Japanese-Tuesday effects are related, but they are consistent with those predicted by international asset pricing models and market efficiency.

Potential Explanations for the Japanese-Tuesday Effect and Its Disappearance

A number of significant events took place in Tokyo throughout the 1980's that appear related to the recent disappearance of the Japanese-Tuesday effect and the emergence of the Japanese-Monday effect. For example, the 1980's witnessed an increase in the globalization of Japanese financial markets. In 1985, Japan relaxed capital market restrictions to allow greater foreign participation in the Tokyo stock market. Foreign firms gained access beginning in 1986 to the floor of the TSE, and NK 225 index futures began trading in 1986 on the SIMEX.

In Japan the *Okurasho* or MOF (Ministry of Finance) exerts considerable influence over financial markets and institutions, and the Ministry actively promotes

higher stock prices. For example, in the early 1990's, the *Okurasho* unofficially banned new equity issues, thereby eliminating any possible source of new stock. More importantly, the *Okurasho* used coercive extralegal pressure of administrative guidance to discourage investors from selling any of their stockholdings and, where possible, to start buying instead (Hartcher (1998), p.104). The Japanese stock market peaked at the end of 1989 and thereafter entered a severe bear market. In response to the decline in Japanese stock prices, the *Okurasho* actively discouraged Japanese financial institutions from selling stocks, and a number of times it implemented so called PKOs (price keeping operations) buying stocks with public funds. According to Hartcher, the word "sell" is absent from the *Okurasho's* vocabulary. The former Nomura chairman, Mr. Aida, says; "The Ministry does not realize that by sending out signals that indicate do not sell, it is giving signals that say do not buy" (*Asahi Evening News*, February 27, 1995).

On the TSE, Monday is the day with the lowest trading volume and liquidity, and furthermore, transactions initiated by foreign investors are especially low on Mondays. However, by Tuesday foreign participation and total trading volume increases to more normal levels. Anecdotal evidence suggests that Japanese financial markets are more transparent on Mondays and less transparent Tuesday through Friday. If a Japanese financial institution desires to hide selling activity from the *Okurasho*, then they will trade on days (or in markets) where transparency is low. Therefore, there is a tendency for Japanese financial institutions to initiate fewer sell transactions on Mondays, and to defer sell transactions to days when both foreign investors and discretionary liquidity traders are more active.

In Japan, regulatory prohibitions on stock lending make it hard to bet on share falls by short-selling borrowed shares in the hope of purchasing them for less and pocketing the difference. Short selling on the TSE is more difficult and costly than on the New York Stock Exchange, and a major impediment to short selling in Japan is the difficulty or even impossibility of borrowing stocks to sell short. Because of short-selling difficulties in Tokyo, good news is likely revealed faster in spot prices than bad news.

NK 225 futures were introduced in 1986 on the SIMEX, and there are no short-selling restrictions in the index futures market. This implies that bad news is revealed faster to the market after the introduction of index futures. Negative information is revealed first in index futures prices, and this information is conveyed rather quickly to spot market participants. Anecdotal evidence suggests that U.S. investors increased their participation in Japanese financial markets, especially on Mondays, after the introduction of NK 225 futures.

In this section, anecdotal evidence is presented suggesting that the level of selling pressure is greater on Tuesday in Tokyo than on other days-of-the-week and more selling pressure on Tuesday potentially is a cause of the Japanese-Tuesday effect. Associated with the introduction of NK 225 futures in 1986 and other factors, the Japanese-Tuesday effect disappears and the Japanese-Monday effect emerges that is exclusively a trading period effect. Some of the behavioral assumptions are conjectural, but in all cases, they are consistent with the personal observations of one co-author working as a financial consultant to Japanese financial institutions.

C. NK 225 Futures and the Linkage from New York to Tokyo

The existence of statistically significant spillover effects from New York to Tokyo is well documented in the literature, but there is little evidence on the strength of this relationship over time. Puffer (1991, p. 421) offers various explanations for the apparent influence of Saturday trading in Tokyo on observed volatility in New York and hypothesizes that the influence of trading in Tokyo on New York has increased over time. From the results presented in Table 1, we hypothesize that the influence of trading in New York on Tokyo has also increased over time.

Over the pre-NK 225 futures period, the absence of U.S. Monday trading has no perceptible influence on surrounding Monday and Tuesday returns in Tokyo, and this is interpreted as evidence that the linkage from New York to Tokyo is "weak." In contrast, over the post-NK 225 futures period, the absence of U.S. Monday trading significantly impacts returns in Tokyo on the surrounding Monday and Tuesday, and this is interpreted as evidence that the linkage from New York to Tokyo is "strong." In any event, the linkage from New York to Tokyo was apparently altered with the introduction of NK 225 futures. For more recent return data, the linkage from New York to Tokyo has increased in intensity, and this result has implications for the benefits derived from international diversification. If the linkage from New York to Tokyo has recently strengthened, then benefits for U.S. investors from international portfolio diversification are potentially reduced. In particular, large negative price changes in New York are now more likely to be followed by large negative price changes in Tokyo.

V. Summary and Conclusions

This paper examines the impact of U.S. Monday holiday closures on Japanese return dynamics for the surrounding Friday, Monday, and Tuesday. Friday TOPIX returns are unusually negative whenever Friday precedes a Monday holiday in New York. Monday and Tuesday TOPIX returns are not impacted by U.S. Monday holiday closures over the first subperiod (1976 through 1986), but the return pattern is altered over the second subperiod (1987 through 1996). For the period 1987 through 1996, Monday TOPIX returns are more positive and Tuesday TOPIX returns are more negative for those days surrounding a Monday holiday in New York.

The empirical evidence does not support the hypothesis that there is a cause and effect relationship between the U.S. Monday and Japanese Tuesday effects. It appears that institutional factors unique to Japan are partially responsible for the Japanese Tuesday effect. These same institutional factors also help explain the recent disappearance of the Japanese Tuesday effect and the emergence of the Japanese Monday effect. These pieces of event evidence are most likely associated with the introduction in 1986 of NK 225 index futures and other institutional changes affecting the globalization of Japanese financial markets. In addition, the linkage from New York to Tokyo has recently strengthened. This phenomenon is at least partially associated with an interaction between the existence of active index futures contracts on both sides of the Pacific (i.e., Nikkei 225 and S&P 500 index futures) and the global leadership of the U.S. stock market.

This paper's empirical results suggest that day-of-the-week return patterns are dynamic and related to market microstructure. Since market microstructure itself is

dynamic, seasonal patterns are subject to change without notice. Financial economists should be careful when making out-of-sample inferences from observed return regularities.

Notes

1. Too many papers have been published on this topic to list here. It is important to note that this phenomenon is a function of the time period and indexes examined.

2. Kato (1990) did not conduct an empirical study to formally test this hypothesis.

3. Half-day Saturday trading on the TSE was eliminated February 1989.

4. Gallant (1987) suggests three lags, and the lag coefficients beyond three are insignificant.

5. Tuesday's TOPIX return is larger than normal over the bull-market period, and there is no evidence of the Japanese-Tuesday effect.

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Table 1
The Impact of U.S. Monday Holiday Closures and Other Factors Affecting Japanese Return Dynamics: 1976-1996

$$R_t = \beta_0 + \beta_1 M_t + \beta_2 T_t + \beta_3 F_t + \beta_4 M_{St} + \beta_5 T_{St} + \beta_6 F_{St} + \beta_7 M_{Ht} + \beta_8 T_{Ht} + \beta_9 F_{Ht} + \beta_{10} G_t + \varepsilon_t$$

R_t is the measured return calculated as the logarithm of the price relative. The variables M_t, T_t and F_t represent dummy variables for Monday, Tuesday and Friday, respectively. A Monday following Saturday trading is given by M_{St}. M_{Ht} represents a Monday preceding a U.S. Monday holiday closure. The coefficient for Friday and Tuesday are constructed in a similar fashion. Variable G_t is a dummy variable capturing the effects of Golden Week. The β_o coefficient represents the returns for both Wednesday and Thursday. The t-statistic is in parenthesis.
*,** Significant at the 0.01 and 0.05 level, respectively.

	A: 1976-1996			B: 1976-1986			C: 1987-1996		
	Close/Close	Close/Open	Open/Close	Close/Close	Close/Open	Open/Close	Close/Close	Close/Open	Open/Close
Normal Days									
Other days: β_o	0.0743%	0.672%	-0.0125%	0.0866%	0.0688%	-0.0189%	0.0573%	0.0601%	-0.0167%
	(10.22)*	(16.55)*	(-1.95)	(12.82)*	(12.48)*	(-3.15)*	(3.05)*	(5.56)*	(-1.07)
Monday: β_1	-0.1851	-0.0237	-0.1547	-0.0855	-0.0057	-0.0774	-0.3013	-0.0441	-0.2464
	(-12.50)*	(-4.25)*	(-13.76)*	(-8.44)*	(-1.48)	(-8.69)*	(-8.56)*	(-2.57)**	(-9.27)*
Tuesday: β_2	-0.1089	-0.0321	-0.0677	-0.1896	-0.0423	-0.1271	-0.0278	-0.0256	0.0041
	(-9.27)*	(-6.35)*	(-6.17)*	(-14.65)*	(-9.34)*	(-12.58)*	(-1.13)	(-1.61)	(0.18)
Friday: β_3	-0.0061	0.0122	-0.0214	0.0042	0.0267	-0.0305	-0.0217	-0.0032	-0.0181
	(-0.565)	(2.04)**	(-2.34)**	(0.38)	(5.28)*	(-3.21)*	(-0.85)	(-0.20)	(-0.81)
Trading Day Following Saturday Trading Tokyo									
Monday: β_4	-0.2338	-0.1945	0.0159	0.1286	0.0793	0.1361	-0.5622	-0.4228	-0.0386
	(-2.92)*	(-5.05)*	(0.17)	(1.46)	(3.12)*	(0.14)	(-3.45)*	(-4.78)*	(-0.20)
Tuesday: β_5	0.3859	0.1034	0.2545	0.0174	-0.0173	0.0491	0.7131	0.1393	0.5367
	(5.14)*	(3.45)*	(4.97)*	(0.23)	(-0.53)	(0.97)	(5.87)*	(1.99)**	(5.970*
Trading Day Preceding Saturday Trading Tokyo									
Friday: β_6	0.2811	-0.0768	0.3803	0.4013	0.0128	0.3922	0.2718	-0.1917	0.5081
	(2.94)*	(-1.71)	(5.09)*	(3.98)*	(0.65)	(4.90)*	(1.61)	(-2.01)**	(3.48)*
Monday Holiday New York									
Monday: β_7	0.2844	0.1739	0.0616	-0.0819	-0.0543	-0.0054	0.5202	0.2808	0.1701
	(3.77)*	(4.79)*	(0.72)	(-0.96)	(-2.28)**	(-0.06)	(4.22)*	(5.30)*	(1.88)
Tuesday: β_8	-0.2655	-0.0915	-0.1489	0.0351	0.0234	-0.0011	-0.3997	-0.1173	-0.2518
	(-3.96)*	(-3.53)*	(-3.46)*	(0.52)	(0.76)	(-0.02)	(-4.24)*	(-3.16)*	(-3.77)*
Friday: β_9	-0.2529	-0.0111	-0.2389	-0.4401	-0.0842	-0.3236	-0.1638	0.0334	-0.2052
	(-2.98)*	(-0.27)	(-3.76)*	(-4.85)*	(-6.56)*	(-4.45)*	(-1.33)	(-0.52)	(-2.15)**
Golden Week Period									
All Days: β_{10}	0.2473	0.0425	0.1922	0.1047	-0.0207	0.1336	0.4485	0.1334	0.2841
	(8.61)*	(2.52)**	(8.30)*	(5.88)*	(-1.79)	(4.42)*	(5.62)*	(2.48)*	(6.89)*

Table 2
Bull Market (1987-1989) versus Bear Market (1990-1993)

$$R_t = \beta_0 + \beta_1 M_t + \beta_2 T_t + \beta_3 F_t + \beta_4 M_{St} + \beta_5 T_{St} + \beta_6 F_{St} + \beta_7 M_{Ht} + \beta_8 T_{Ht} + \beta_9 F_{Ht} + \beta_{10} G_t + \varepsilon_t$$

R_t is the measured return calculated as the logarithm of the price relative. Lagged returns are omitted for simplicity. The variables M_t , T_t and F_t represent dummy variables for Monday, Tuesday and Friday, respectively. M_{Ht} represents a Monday preceding a U.S. Monday holiday closure. The coefficient for Friday and Tuesday are constructed in a similar fashion. Variable G_t is a dummy variable capturing the effects of Golden Week. The β_0 coefficient represents the returns for both Wednesday and Thursday. Due to the dynamic relationship inherent in equation (1), the parameter estimates for close-close returns are not equal to, but are approximately equal to the sum of the parameter estimates for close-open and open-close returns. The t-statistic is in parenthesis. The superscript * and ** denote significance at the 0.01 and 0.05 level, respectively.

	Bull Market Tokyo A; 1987-1989			Bear Market Tokyo B: 1990-1993		
	Close/Close	Close/Open	Open/Close	Close/Close	Close/Open	Open/Close
Normal Days						
Other days: β_0	0.1918%	0.1848%	-0.0570%	-0.0043%	0.0156%	-0.0220%
	(7.08)*	(17.40)*	(-1.97)	(-0.13)	(1.06)	(-0.95)
Monday: β_1	-0.3358	-0.0739	-0.2486	-0.3348	-0.1487	-0.2731
	(-8.68)*	(-3.88)*	(-6.47)*	(-5.24)*	(-1.64)	(-6.36)*
Tuesday: β_2	-0.1824	-0.1269	-0.0242	0.0084	0.0152	-0.0121
	(-4.82)*	(-6.11)*	(-0.75)	(0.17)	(0.54)	(-0.35)
Friday: β_3	-0.0561	-0.0067	-0.0384	0.0006	-0.0081	0.0073
	(-1.69)	(-0.34)	(-1.61)	(0.01)	(-0.28)	(0.19)
Monday Holiday New York						
Monday: β_7	0.4994	0.1989	0.2509	0.5981	0.3587	0.1212
	(3.49)*	(3.82)*	(1.81)	(3.81)*	(5.15)*	(0.56)
Tuesday: β_8	0.2806	0.1341	0.1018	-0.6552	-0.2348	-0.3328
	(2.16)**	(2.99)*	(0.79)	(-6.74)*	(-4.92)*	(-4.55)*
Friday: β_9	-0.3919	0.1502	-0.5521	-0.1799	-0.0512	-0.0998
	(-2.19)**	(6.73)*	(-3.13)*	(-1.33)	(-0.67)	(-0.95)
Golden Week Period						
All Days: β_{10}	0.5529	0.2058	0.2834	0.6024	0.2658	0.2793
	(11.17)*	(2.81)*	(6.37)*	(12.33)*	(3.49)*	(2.95)*