“The influence of U.S. equity returns on Asian-Pacific equity markets”

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THE INFLUENCE OF U.S. EQUITY RETURNS ON ASIAN-PACIFIC EQUITY MARKETS

Abstract

This paper examines monthly and daily returns in eleven Asian-Pacific equity markets and the U.S. market, showing that the Asian-Pacific markets systematically follow the returns in the U.S. market (S&P 500 index). For investment managers, the important findings include the fact that each Asian-Pacific market moves differently in response to U.S. market changes over a given time period and the response of most of these markets to changes in the U.S. market is not stable over time. Therefore, in their attempt to diversify a portfolio using individual Asian-Pacific country equities, past correlations and covariances are not necessarily a good predictor of future values, especially for the less developed countries. On average, more developed markets react more strongly to U.S. market changes than do the less developed markets. All markets exhibit asymmetries relative to the U.S. market, where reactions are stronger following down-days than following up-days. Finally, the tests suggest that the Asian-Pacific markets have little or no influence on U.S. market returns.

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INTRODUCTION

The benefits of international portfolio diversification are well-documented in both theory and practice as are the movements and co-movements and the linkages between many international indexes. However, much of this research was done in the 1980s and 1990s before the existence of stock exchanges and indexes in many countries. Data are now available over several years for many of the newer markets. The purpose of this paper is to investigate the linkages (and spillover effects) that exist among the Asian-Pacific equity markets – and, specifically, the impact of the U.S. market on these markets – to provide current information to investment managers. This study looks at many more Asian-Pacific markets than have been examined in most other studies and looks at some newer markets for which the linkages have never been examined. In addition, it looks at a much longer time span than past studies – by examining linkages in five different periods over more than 25 years from 1985 to 2011.

Past research suggests that Asian-Pacific equity markets tend to follow the lead of the U.S. market, and that the U.S. market tends to be the dominant market in the world when it comes to lead-lag relationships. Much of the research has focused on the relationship between U.S. equity markets and equity markets in Japan and Hong Kong. Little research, however, has been done with respect to the direction and influence of the U.S. market on many of the other individual country equity markets in the Asian-Pacific region, particularly those of the newer, developing economies.

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This paper focuses on the linkages between the U.S. equity market, using the S&P 500 index, and the markets in Australasia and Asia. These linkages are examined using individual country index returns and are examined both over time and across markets[1].

This paper is not a time-series analysis because it focuses primarily on those days when the returns in the U.S. have an absolute value equal to or greater than 1 percent, which greatly reduces the sample size[2].

A reverse linkage – the impact of Asian markets on the U.S. market – is also tested. Finally, the paper measures the asymmetric movement of returns by separately examining positive and negative returns in U.S. markets and the response of Asian-Pacific markets to these changes. The focus is on specific estimates for individual countries while using the data that are readily available to investors.

1. LITERATURE REVIEW

1.1. International diversification and time-varying return correlations

International diversification has been studied by scholars for over fifty years starting with the work of Grubel (1968) and Levy and Sarnat (1970). They conclude that international diversification provides significant benefits to investors, particularly by including equities from both developed countries and less developed economies. Since these initial studies, many subsequent papers (see Shawky, Kuenzel, & Mikhail, 1997) have documented the potential gains from international diversification, as well as the increasing correlations of returns among developed economies in the latter part of the 20th century (for example, see Longin & Solnik, 1995). More recently, Eun, Huang, and Lai (2008) show that better portfolio diversification can be realized by using small-cap international stocks than by using large-cap international stocks (using data from 1980 to 1999). Further, it has also been shown that investors who are less risk averse may benefit more from international diversification than those with a higher level of risk aversion (see Fernandes & Ornelas, 2010). Three studies that focus on the contribution of emerging markets to international diversification are by Errunza (1977), Harvey (1995), and T. Kohlers, G. Kohlers, and Pandey (1998). All three studies document the risk-reduction benefits. And, going one step further, Harvey (1995) suggests that including emerging market securities in a portfolio increases the expected return.

Bookstaber (2007) and Asness, Israelov, and Liew (2011) approach the international diversification in light of the 2007–2009 world financial crisis. Both discuss the fact that all markets crashed at the same time (i.e., higher correlation in down markets). Bookstaber (2007) says that this was caused by greater "complexity" (the use of complex derivative strategies) in the world's financial markets, as well as "tight coupling" (linkages caused by the overuse of debt). Asness, Israelov, and Liew (2011) show that the simultaneous crashing of financial markets can be offset, in part, through international diversification. They look at a 58-year period (ending in 2008) for 22 countries, finding that an equally-weighted global portfolio outperformed (in most cases) the worst monthly country returns.

The correlations and covariances of international returns have been found to vary across time. This tendency has been documented by Kaplanis (1988), Longin and Solnik (1995), Erb, Harvey, and Viskanta (1994), Gupta and Mollik (2008), Horn (2010), and Benson and Kong (2015). Using the data from 1970 to 1993, the shifts in correlations over time have been examined by Erb, Harvey, and Viskanta (1994). They find that the shifts are associated with changes in economic activity, particularly the changing business cycle phases and changes in the structure of industrial activity. Gupta and Mollik (2008) specifically look at the correlation shifts between eleven emerging markets and Australia's equity market. The correlation shifts between most markets appear to be related to the volatility in the emerging markets. Looking at a 39-year period that ends in 2009, Horn (2010) examines the correlations of monthly returns between the MSCI EAFE index and the S&P 500 index. Over this time, there were six bull markets and six bear markets. The average correlation was .45 in bull markets and .73 in bear markets. Each of the correlations shifted over time, with the bull market correlation moving from .35 to .65 and the bear market correlation moving from .60 to .91. Benson and Kong (2015) show that the correlations and covariances of Asian-Pacific equity markets with the U.S. vary greatly over time and across markets.

1.2. Bull and bear markets and market volatility

In addition to the above study that shows asymmetric correlations in up and down markets, Erb, Harvey, and Viskanta (1994) also found that correlations are much lower in rising markets. In a study using the data from 1970 to 1993, they found that the average correlation between the U.S. market and other G7 countries was .42 in bear markets and only .26 in bull markets. In addition, they found that asset allocations are significantly altered when "expected correlations" are used in place of historical correlations in international portfolio diversification models.

Next, several studies have examined the impact of market volatility on international equity correlations. Rising correlations and covariances between international equity markets during the periods of increasing market volatility have been found by both Longin and Solnik (1995) and Solnik, Boucrelle, and Le Fur (1996). Following this, Li (2007) also shows that correlations are the highest when volatility is the greatest. His "state varying correlation" model is used to estimate future correlations that provide more efficient portfolio design. Page and Panariello (2018) discuss the failure of traditional diversification techniques to consider "non-normal" left-tail risk. They suggest that scenario analysis should play a bigger role in portfolio creation and that investors should use strategies such as hedging, defensive momentum, and dynamic risk control to manage the volatility.

1.3. The global transmission process and daily returns

One of the first studies to look at rate of return transmission between markets is Agmon (1972). Using natural logs of monthly price relatives (1955–1966) to investigate U.S., UK, Germany, and Japan equity price changes, he shows that German equities move the most in response to U.S. stock price changes (having a beta of 0.71 relative to the U.S. index). Shares in the UK and Japan markets had betas less than 0.50. Studies by Ripley (1973) and Panton, Lessig, and Joy (1976) investigate the linkages among numerous equity markets in developed countries. Ripley (1973) uses monthly price data from 1960 to 1970 for 19 developed countries' stock exchanges and uses changes in logs. He found that the markets of the U.S., Canada, Switzerland and the Netherlands were most likely to be influenced by common factors, while the markets in Denmark and Finland were related to more unique factors. Panton, Lessig, and Joy (1976) use weekly stock market rates of return to investigate 12 equity markets from 1963 to 1972. They found that adjusting data for exchange rates made no difference in their findings. They found a high degree of comovement between markets in the U.S., Canada, Switzerland, the Netherlands, and Germany, with Austria and Italy being the least similar.

Khoury, Dodin, and Takada (1987) examine daily return data from 1975 to 1983 for five developed countries. They adjusted for holidays by deleting the data for holiday dates. They found that the U.S. equity market is the clear leader relative to the other four markets. The relationship is especially strong for the U.S. leading the Japanese market and moderate for Canada, France, and Germany. They suggest that an index of the U.S. market could easily substitute as an index for the world. Bennett and Kelleher (1988) examine world markets (US, UK, West Germany, and Japan) from 1972 to October 1987, focusing on the market disruptions caused by Black Friday. Using the daily returns, they show that the volatility of returns (standard deviation) and correlation both increased around the 1987 crash. Higher volatility in one market is followed by higher volatility in the markets that open and close later than the first market. Also, higher volatility leads to higher correlations between that market and other markets and leads to higher betas. Finally, Eun and Shim (1989) examine the linkages using daily returns in the world's nine largest equity markets (for 1980–1985). They find that the U.S. market is the most influential of the world markets.[3]

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1.4. Asian market linkages

Three studies focus on the return linkages between U.S. and Japanese equity markets. Becker et al. (1990) examine the daily return linkages from October 1985 to December 1988. While they find no impact of Japanese markets on the U.S., they find returns on the S&P 500 index have an impact on overnight and subsequent daily returns in Japan. Lin, Engle, and Ito (1991) separate daytime returns and overnight returns in their study of daily transmission mechanisms between the U.S. and Japanese markets over 1985–1989 period. They find that the daytime returns in one market influence the overnight returns in the other market. They also find relatively symmetric return influences across the two markets, with the impact of Japan on the U.S. being similar to the impact of the U.S. on Japan. Becker, Finnerty, and Tucker (1992) also look at the intraday trading linkages between the U.S. and Japan over the 1985 to 1989 period by looking at hourly returns. They find that the reaction of one market to the other takes place largely in the first hour of trading (rather than showing up at the market opening) due to prices being "sticky" at the opening – meaning that a lot of stocks have not yet traded[4]. Cheung and Mak (1992) examine the impact of the U.S. and Japan on eight Asian-Pacific markets. Looking at weekly index returns from 1977 to 1988, they found that the U.S. market has a more significant impact on these markets than does Japan. They found significant lags in the impact, and the impact on Korea, Taiwan, and Thailand is limited due to their being less open to foreign investors.

Three studies look at both price and volatility linkages. Koutmos and Booth (1995) examine price and volatility impacts across U.S., UK, and Japanese markets using daily open-to-close returns. Using 1,700 observations over a period from 1986 to 1993, they find significant price impacts (or "spillovers") from the S&P 500 to the Nikkei 225 and from the Nikkei 255 to both the FTSE-100 and the S&P 500. Besides, they find that price change size affects the variances of returns in the next markets that trade (called "volatility spillovers"). Finally, they find significant asymmetries in volatility transmission, where negative price changes lead to double or triple the price volatility of the next market compared to positive price changes. Wei et al. (1995) examine the return and volatility spillover in the U.S., UK, Japan, Taiwan, and Hong Kong in 1991–1992. They find that the U.S. market (compared to Japan) has greater influence on markets in Taiwan and Hong Kong. Liu and Pan (1997) focus on the return and volatility spillover effects from 1984 to 1991. They find that the U.S. market returns had a positive and significant impact on the returns in Japan, Hong Kong, and Singapore. There was no impact on Taiwan, and the spillover effect on Thailand was negative. They found little or no volatility spillover for these markets.

Several more recent studies, including Cha and Oh (2000), Chang and Nieh (2001), Dekker, Sen, and Young (2001), and Cheng and Glascock (2006), have used vector autoregression (VAR) to examine the market linkages. Cha and Oh (2000) found that the linkages between the developed and developing markets became stronger after October 1987 market crash and that these relationships "intensified" after the Asian financial crisis in July 1997. Chang and Nieh (2001) measure the returns using log price changes of daily stock index data[5]. They find that the Hong Kong market is affected by changes in both Japan and U.S. markets, but that changes in the Taiwan stock market are not affected by either one. Dekker, Sen, and Young (2001) using the data from 1987 to 1998 find that there are strong linkages between the Asian-Pacific markets, with the U.S. market having a strong influence on all the other markets, except Taiwan. Cheng and Glascock (2006) find that after the Asian crisis, there is an increase in the influence of the U.S. market and greater co-movement among markets.

Kolluri, Machuga, and Wahab (2014) examine the impact (and asymmetries) of the U.S. and Japanese markets on monthly returns in nine Asian markets from 1993 to 2008 (192 observations for each market). Using GARCH and EGARCH models, they find that the U.S. market dominates Japan in its effect on the other nine Asian markets. They also find significant asymmetries with the co-movements being much greater during down markets.

2. METHODOLOGY AND DATA

This paper looks not only at the impact of the U.S. market on Asian-Pacific markets, but also tests for an impact of the Asian-Pacific markets on the U.S.

To accomplish these goals, tests of the four following hypotheses are conducted:

H1: *Asian-Pacific equity market monthly returns are not affected by U.S. equity market monthly returns. Here the tests use standard calculations of monthly betas.*

H2: *Asian-Pacific equity market daily returns are not affected by U.S. equity market daily returns. Here the tests focus only on the larger changes (greater than 1% or less than –1%) in the U.S. with the belief that investment managers may wish to react to large changes, but not to small daily changes that are more random and less impactful on Asian markets.*

H3: *U.S. equity market daily returns are not affected by Asian-Pacific equity market daily returns.*

H4: *The upward moves in Asian-Pacific equity markets following a move up in U.S. equity markets are symmetric to the downward moves in these markets.*

The focus in the empirical section is linear regression analysis where we examine whether the return in one market is affected by the return in another market that has recently closed for the day. This methodology is superior to simply looking at correlation coefficients between markets[6]. By calculating a coefficient (or beta) that shows how one market's return, on average, reacts to the return on another market, a low risk asset (or equity market) is one that has a low standard deviation of returns and a low correlation of returns with the subject market.

This study uses market index price data obtained from Yahoo Finance website. The eleven Asian-Pacific indices used in this analysis (shown in Table 1) were chosen because of their availability in Yahoo Finance. In addition, one index from India, as well as those from the UK, Germany, and France were selected. These additional indexes may be used as comparisons to the Asian-Pacific indexes and are used in tests of how the foreign markets affect the U.S. market (see Table 4). The characteristics of these country equity market indexes are shown in Table 1.

Table 1. Characteristics of markets and market indexes

Country	City	Index name	Abbrev.	Beginning date	Market cap in 2012*	New York time Open	New York time Close	Hours open	Overlap with NYSE	Local time Open	Local time Close
U.S.	New York	S&P 500	^GSPC	1/3/1950	$18,668 B	9:30 AM	4:00 PM	6.5	–	–	–
Japan	Tokyo	Nikkei 225	^N225	1/4/1984	3,681 B	7:00 PM	1:00 AM	6	0	9:00 AM	3:00 PM
China	Hong Kong	Hang Seng	^HSIX	12/31/1986	1,108 B	9:00 PM	4:00 AM	7	0	9:00 AM	4:00 PM
Singapore	Singapore	Straits Times	^STI	12/28/1987	414 B	8:00 PM	4:00 AM	8	0	9:00 AM	5:00 PM
Australia	Sydney	All Ordinaries	^AORD	8/3/1984	1,286 B	7:00 PM	1:00 AM	6	0	10:00 AM	4:00 PM
New Zealand	Wellington	New Zealand Exchg 50	^NZ50	4/30/2004	80 B	5:00 PM	12:00 AM	7	0	10:00 AM	5:00 PM
Korea	Seoul	Kospi Composite	^KS11	7/1/1997	1,180 B	7:00 PM	1:00 AM	6	0		
Taiwan (China)	Taipei	Taiwan Composite (Wtd)	^TWII	7/2/1997	672 B	8:00 PM	12:30 AM	4.5	0	9:00 AM	1:30 PM
Indonesia	Jakarta	Jakarta Composite	^JKSE	7/1/1997	397 B	9:30 PM	4:00 AM	6.5	0	9:30 AM	4:00 PM
Malaysia	Kuala Lumpur	FTSE Malaysia	^KLSE	12/3/1993	476 B	8:00 PM	4:00 AM	8	0	9:00 AM	5:00 PM
Thailand	Bangkok	Dow Jones Thailand	^THDOWD	1/3/2000	383 B	10:00 PM	4:30 AM	6.5	0	10:00 AM	4:30 PM
China	Shanghai	Shanghai Composite	^SSEC	1/4/2000	3,697 B	8:30 PM	2:00 AM	5.5	0	9:30 AM	3:00 PM
India	Mumbai	BSE 30	^BSESN	7/1/1997	1,263 B	11:30 PM	6:30 AM	7	0	9:00 AM	4:00 PM
UK	London	FTSE 100	^FTSE	4/2/1984	3,019 B	3:00 AM	11:30 AM	8.5	2h		
Germany	Frankfurt	DAX	^GDAXI	11/26/1990	1,486 B	3:00 AM	2:00 PM	11	4.5h	9:00 AM	8:00 PM
France	Paris	CAC40	^FCHI	3/1/1990	1,823 B	3:00 AM	11:30 AM	8.5	2h	9:00 AM	5:30 PM

Note: *The market capitalizations by country are from the Quandl website and are taken from World Bank statistics, except for Taiwan (China), whose numbers are estimated from 2015 market capitalization numbers found on Wikipedia and are adjusted using the TWII index on Yahoo Finance.

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The entire daily closing price history for each index was downloaded from Yahoo Finance. The non-U.S. index with the longest price history is the Nikkei 225, which started on January 4, 1984, while the shortest price history is for the New Zealand Exchange 50, which began on April 30, 2004. The prices in Yahoo Finance are in local currencies, so currency exchange rates are not included in the initial return calculations. Intraday returns cannot be analyzed with the data because the data source includes only the open and closing values, not hourly data.

Returns are calculated as $(P_1-P_0)/P_0$, using the adjusted prices from Yahoo Finance. Returns on each foreign index are matched with the corresponding returns on the S&P 500 index for both monthly and daily data series. Monthly data for the foreign indexes is adjusted for exchange rate movements. The relevant comparison is to use the returns calculated from S&P 500 month-end closing prices compared to the returns calculated from foreign index beginning-of-the-month closing prices. Thus, U.S. returns are matched with the foreign index returns that immediately follow the S&P 500 returns, even though the foreign returns are on day "*t*+1"[7]. In other words, if the month-end S&P 500 return uses the April 30 closing price, the foreign market month-end return uses the closing price for May 1.

The daily data are difficult to work with because of the many trading day holidays in both the U.S. and foreign markets. Since the holidays are different in each country, a different daily return sample size was developed for each country with respect to the S&P 500. When working with each foreign index, the process involved matching each daily return on day "*t*" with the corresponding S&P 500 return on day "*t*–1". If the foreign market had a holiday on any given day "*t*", the S&P 500 index price on day "*t*–1" was deleted. In this case the foreign market return from day "*t*–1" to day "*t*+1" was matched with the S&P 500 return from day "*t*–2" to day "*t*"[8]. Further, if the U.S. market was observing a holiday on day "*t*", the foreign market price was deleted for day "*t*+1". For example, when the U.S. market observes the Memorial Day holiday on the last Monday in May, the following Tuesday index price in the foreign market was deleted from the sample for all foreign markets[9]. In this case, the return from Friday to Tuesday on the S&P 500 is matched with the foreign index return from Monday to Wednesday. Daily returns are not adjusted for daily currency exchange rate changes, since previous research by Panton, Lessig, and Joy (1976), Hughen and Mathew (2009), and Levy and Lieberman (2013) suggests that the inclusion of currency changes has little impact on daily returns.

3. EMPIRICAL FINDINGS

3.1. Individual market linkages

3.1.1. U.S. market impacts on Asian-Pacific markets

While the focus of this paper is on the reaction of Asian-Pacific markets to daily U.S. equity returns, the first analysis focuses on monthly returns, since this is the standard way that stock market "betas" are calculated. The monthly beta estimates are presented in Table 2, using the S&P 500 index as the measure of the market[10]. These estimates are made using the S&P 500 index and the index in eleven Asian-Pacific countries and India, plus the UK, Germany, and France for comparison purposes. Thus, the model, in functional form, is: Foreign Index Return = *f*(S&P 500 Return), similar to the methodology used by Agmon (1972). The data are broken into 5-year time periods, except for the first time period, which is based on the start of the data in Yahoo Finance, and the last time period that extends from 2005 to 2011.

The betas shown in Table 2 vary over a wide range and most are statistically significant. The final two columns in the table show the average beta across all time periods and the standard deviation of beta. The country with the highest average beta is Hong Kong, with 1.17. The countries with the greatest variability in beta are Malaysia, Indonesia, and India. For example, the beta estimates for Indonesia fluctuated from 1.57 to 0.52 to 1.12 in the three periods going from 1995 to 2011. The highest betas in the table are for Malaysia and Indonesia in 1995–1999 period, and the lowest is .01 for China (a statistically insignificant value). Focusing on the estimates from 2005 to 2011, the highest betas are for Hong Kong and India (1.20

Table 2. Beta estimates for regressing the foreign index monthly returns (based on month-beg. prices) on the S&P 500 index monthly returns (based on month-end prices) [e.g., Nikkei 225 = *f*(S&P 500)] using all S&P 500 monthly returns*

Abbrev.	Index name	2005–2011		2000–2004		1995–1999		1990–1994		1985–1989		Average	
		Coeff.	*t*-stat	Coeff.	*t*-stat	Coeff.	*t*-stat	Coeff.	*t*-stat	Coeff.	*t*-stat	Coeff.	Std. dev.
^N225	Nikkei 225	0.96	10.17	0.58	3.97	0.56	2.73	0.91	3.39	0.46	4.82	0.74	0.20
^HSIX	Hang Seng	1.20	10.72	0.91	7.11	1.49	6.01	0.92	3.37	1.31	5.96	1.17	0.23
^STI	Straits Times	1.09	12.22	0.79	5.90	1.41	6.02	0.91	4.82	0.90	3.64	1.03	0.20
^AORD	AllOrdinaries	0.90	16.27	0.41	7.04	0.58	6.68	0.68	4.78	0.68	4.48	0.69	0.15
^NZ50	New Zealand Exch 50	0.59	9.58	–	–	–	–	–	–	–	–	0.59	–
^KS11	Kospi Composite	1.03	9.25	1.14	6.20	1.06	1.91	–	–	–	–	1.06	0.04
^TWII	Taiwan Comp. (Wtd)	1.05	10.51	0.83	3.86	0.95	3.18	–			–	0.97	0.09
^JKSE	Jakarta Composite	1.12	9.04	0.52	2.67	1.57	2.97	–	–	–	–	1.08	0.43
^KLSE	FTSE Malaysia	0.57	7.81	0.28	1.79	1.56	4.71	–	–	–	–	0.75	0.55
^THDOWD	Dow Jones Thailand	1.07	6.77	0.98	4.11	–	–	–	–	–	–	1.04	–
^SSEC	Shanghai Composite	0.91	4.23	0.01	0.08	–	–	–	–	–	–	0.61	–
^BSESN	SENSEX (BSE 30)	1.29	9.04	0.60	2.98	0.34	1.13	–	–	–	–	0.88	0.40
^FTSE	FTSE 100	0.88	14.67	0.72	10.06	0.64	6.91	0.89	7.13	0.92	10.46	0.82	0.10
^GDAXI	DAX	1.11	13.93	1.22	8.86	1.07	7.49	0.46	2.25	–	–	1.00	0.33
^FCHI	CAC40	1.06	14.98	0.94	8.82	0.94	5.74	0.72	3.73	–	–	0.94	0.14

Note: *The month-beginning price for the foreign index is for the next day after the month-end price is collected for the S&P 500 index.

and 1.29, respectively) and the lowest are for New Zealand and Malaysia (0.59 and 0.57, respectively). Also, during this period, the betas for most of the countries are higher than are the averages over the five time periods, which tends to confirm the results found by Bennett and Kelleher (1988). The beta coefficient for Taiwan for 2005–2011 period indicates a strong influence from the U.S. market, which is in contrast to the "no influence" finding of Chang and Nieh (2001) and Dekker, Sen, and Young (2001) for the period of the 1990s. All but three of the estimated betas in Table 2 are statistically significant. Therefore, Hypothesis 1 that the Asian-Pacific monthly returns are not affected by U.S. monthly returns may be rejected.

Table 3 presents the "beta" estimates based on daily returns, using the S&P 500 index as the market index, for all of the foreign market indexes and time periods used in Table 2 for the monthly return data[11]. The estimates in Table 3 use only those S&P 500 returns that have an absolute value equal to or greater than 1 percent[12]. The paper focuses on these large daily changes, because portfolio managers and traders of Asian-Pacific equities may wish to react quickly to large U.S. daily changes, but would ignore the small day-to-day fluctuations that have little influence on other markets. The model, in functional form, is: Foreign Index Return$_{t+1}$ = *f*(S&P 500 Return$_t$), so the foreign index returns are those immediately after the U.S. returns. The coefficients in Table 3 show how much of the daily U.S. market change in return was reflected, on average, in the daily return change in the foreign market for each time period. The daily returns used for these regressions were based on index close-to-close values. The coefficients in Table 3 are all lower than the "monthly" betas reported in Table 2 (except for one statistically insignificant beta for the Shanghai market), and none of the coefficients in Table 3 are greater than 1.0[13]. The only coefficient that is not statistically significant is that for the Shanghai Stock Exchange index in 2000–2004 period (a period when "decoupling" was often used for U.S.-China). The highest value in the table is the 0.89 for the Hang Seng index during the dot-com boom from 1995 to 1999. The lowest statistically significant coefficient is 0.16 for the Jakarta Composite for 2000–2004. The markets with the highest average coefficients over the entire time period (the length

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of the time period varies from market to market) are Hong Kong (0.66), Korea (0.55), Japan (0.52), Singapore (0.48), and Australia (0.47). Focusing on 2005–2011 period, the markets whose daily equity returns follow most closely to the U.S. daily equity returns are more developed markets of Japan, Hong Kong, and Australia. The emerging markets are the least affected by daily changes in the S&P 500 (as well as the European markets). For 2005–2011 period, which includes the financial crisis, most of the coefficients are higher than for the previous 5-year period, with the Kospi Index for Korea being the only index for which there was a sizable decrease in the regression coefficient. In general, the coefficients for a given Asian-Pacific index vary quite a bit across time, especially for Malaysia and Indonesia. This evidence allows us to reject Hypothesis 2, that the Asian-Pacific daily returns are not affected by U.S. daily returns.

Several lessons can be learned from the results in Table 3. First, over the entire time period, more developed markets in the Asian-Pacific (such as Japan, Hong Kong, and Korea) react, on average, more strongly to U.S. equity market changes than do the markets in less developed markets (such as China, Thailand, and Malaysia). During the most recent time period, those that had the highest coefficients were Japan, Hong Kong, and Australia, while those with the lowest coefficients (that were about 50% smaller) were China, Malaysia, and Thailand. It appears that this dichotomy exists, because Asian-Pacific countries that are more complex and fully developed have a mixture of stocks (companies) that more closely mirror the changes that take place in the U.S. On the other hand, countries that are in an earlier stage of development have a simpler, less complex economy that is affected more by a unique set of factors. Also, the higher level of economic integration of the mature economies may lead to these stock markets moving more closely together. Second, the variability of the coefficient estimates from one time period to another is greater in less developed markets such as Indonesia and Malaysia. This is most likely due to the fact that there are a larger number of unique factors that affect these developing markets, and they are less integrated with more developed economies. Thus, they have a less stable relationship with the U.S. equity market. Finally, both Table 2 and 3 suggest that "betas" across time are not stable for any given country (an exception may be Taiwan). This instability could be due to structural changes that occur within nations over time or could be due to a myriad of unique factors that may affect the relationship between Asian-Pacific equity markets and the U.S. In any case, using a single country's "beta" from the past to predict future beta may not provide an accurate prediction.

3.1.2. Asian-Pacific market impacts on the U.S.

To test Hypothesis 3, the model is reversed to: S&P 500 Return$_t$ = f(Foreign Index Return$_t$). For these

Table 3. Regression coefficients (or betas) for regressing the foreign index daily returns on the S&P 500 index [e.g., Nikkei 225$_{t+1}$ = f(S&P 500$_t$)] using S&P 500 daily returns of +/–1% or higher

Abbrev.	Index name	2005–2011			2000–2004		1995–1999		1990–1994		1985–1989		Average	
		Coeff.	*t*-stat	R^2	Coeff.	*t*-stat	Coeff.	*t*-stat	Coeff.	*t*-stat	Coeff.	*t*-stat	Coeff.	Std. dev.
^N225	Nikkei 225	0.64	22.48	0.48	0.5	14.9	0.44	9.12	0.59	7.32	0.44	17.13	0.52	0.08
^HSIX	Hang Seng	0.54	14.15	0.27	0.51	15.34	0.89	11.55	0.58	8.63	0.77	7.69	0.66	0.15
^STI	Straits Times	0.37	12.96	0.24	0.34	11.3	0.56	9.79	0.47	8.06	0.67	10.27	0.48	0.12
^AORD	AllOrdinaries	0.5	23.36	0.5	0.31	21.25	0.46	19.16	0.45	12.62	0.65	17.56	0.47	0.11
^NZ50	New Zealand Exchg 50	0.32	26.24	0.56	–	–	–	–	–	–	–	–	0.32	–
^KS11	Kospi Composite	0.42	13.03	0.24	0.66	13.5	0.55	4.98	–	–	–	–	0.55	0.1
^TWII	Taiwan Composite (Wtd)	0.4	14.96	0.29	0.37	8.9	0.36	6.12	–	–	–	–	0.38	0.01
^JKSE	Jakarta Composite	0.42	13.42	0.26	0.16	4.46	0.62	6.61	–	–	–	–	0.4	0.19
^KLSE	FTSE Malaysia	0.22	14	0.27	0.2	7.76	0.7	8.59	–	–	–	–	0.37	0.23
^THDOWD	Dow Jones Thailand	0.3	9.23	0.14	0.31	7.62	–	–	–	–	–	–	0.3	–
^SSEC	Shanghai Composite	0.24	7.14	0.09	0.02	0.68	–	–	–	–	–	–	0.13	–
^BSESN	SENSEX (BSE 30)	0.32	8.42	0.12	0.18	5.26	0.27	4.57	–	–	–	–	0.26	0.06
^FTSE	FTSE 100	0.26	9.17	0.13	0.29	8.75	0.32	9.73	0.3	7.38	0.33	10.18	0.3	0.02
^GDAXI	DAX	0.23	7.08	0.08	0.18	3.82	0.49	10.64	0.38	6.26	–	–	0.32	0.12
^FCHI	CAC40	0.29	8.78	0.12	0.35	8.67	0.4	9.28	0.33	4.88	–	–	0.34	0.04

tests, the data set is reordered so that the relevant comparison is the foreign market return on day "*t*" and the subsequent U.S. market return on that same day "*t*". This is more complex to test for at least three reasons. First, no single Asian-Pacific market alone affects the U.S. market, so it may be better to look at the combination of stock markets in several countries or the whole region rather than individual countries. Second, some of the larger Asian-Pacific markets may be expected to have a larger impact on the U.S. stock market than do smaller markets in emerging economies. Third, European markets likely have greater impact on U.S. markets than do Asian-Pacific markets, since they are open after the Asian-Pacific markets, and since the hours they are open overlap somewhat with the U.S. open hours (see Table 1). So, tests of the impact of Asian-Pacific markets on the U.S. market may best be examined in combination with the impact of European markets.

This paper first uses bivariate regression estimates to test how the daily price movement of the U.S. market is related to the price movement in several of the larger Asian-Pacific markets that closed earlier on the same day. Next, multiple regression will be used to examine the combined impact of several different markets on the U.S. market. Table 4 shows the results of the bivariate regressions using each of the largest Asian-Pacific stock market returns as predictors of the S&P 500 return. Two time periods were used for this analysis: 2005–2011 and 2000–2004. For each time period and for each Asian-Pacific market, the return on the S&P 500 was used only on those days that the foreign market was active. Thus, a foreign stock market that has more holiday closings, like the Shanghai Stock Market in China, has a smaller final sample size in each period. The bivariate model regression coefficients range from zero to 0.20, and all but one are statistically significant. These coefficients, however, are far lower than the coefficients in Table 3 that measure the impact of the S&P 500 returns on individual Asian-Pacific stock market returns, where the coefficients tend to be in the range from 0.20 to 0.60.

The low coefficients for the bivariate regressions are not surprising, because by the time the Asian-Pacific markets have closed, the European markets are open, and are open for roughly six hours before the U.S. market opens. Also, there is some overlap of the hours the European markets and U.S. market are open. For example, the overlap is 4½ hours with the German stock market, as shown in Table 1. Therefore, one would expect the U.S. stock market to be influenced much more by the action in Europe than by what happened in the

Table 4. Regression coefficients (or betas) for regressing the S&P 500 index daily returns on the foreign index daily returns [e.g., S&P $500_t = f(\text{Nikkei } 225_t)$]

Bivariate regressions

Abbrev.	Index name	2005–2011				2000–2004				Market capitalization (billions)		
		Coeff.	*t*-stat	R^2	N	Coeff.	*t*-stat	R^2	N	2012	2007	2002
^N 225	Nikkei 225	0.11	5.43	0.017	1,666	0.1	4.22	0.015	1,186	3681	3220	3041
^HSIX	Hang Seng	0.19	10.35	0.06	1,690	0.11	4.4	0.016	1,200	1108	1329	551
^AORD	AllOrdinaries	0.17	6.02	0.021	1,728	0.13	2.46	0.005	1,233	1286	676	585
^KS11	Kospi Comp	0.2	9.2	0.048	1,689	0.07	3.88	0.013	1,181	1180	495	330
^TWII	Taiwan Comp	0.14	5.62	0.019	1,677	0.07	3.72	.012	1,191	672	818	450
^SSEC	Shanghai composite	0.05	2.64	0.004	1,646	–0.02	–0.74	.000	1,148	3697	2794	681
^FTSE	FTSE 100									3019	1852	2460
^GDAXI	DAX									1486	1108	1079
^FCHI	CAC40									1823	1492	1356

Multivariate regressions

Periods	FTSE		N 225				Euro Index		Asia Index			
	Coeff.	*t*-stat	Coeff.	*t*-stat	R^2	N	Coeff.	*t*-stat	Coeff.	*t*-stat	R^2	N
2005–2011	0.64	30.47			0.345	1,763	0.65	34.21	–	–	0.4	1,763
2005–2011	0.67	30.42	–0.09	–4.77	0.354	1,763	0.68	33.52	–0.10	–4.44	0.406	1,763
2005–2011 (FTSE > +/–1%)	0.72	21.17	–0.13	–3.78	0.472	542	0.71	23.55	–0.14	–3.13	0.517	600
2000–2004	0.46	18.35	–	–	0.212	1,255	0.5	23.22	–	–	0.301	1,255
2000–2004	0.46	17.78	0.01	0.33	0.212	1,255	0.51	22.66	–0.04	–1.35	0.302	1,255

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Asian-Pacific based on time alone. Add to that the greater cultural similarities (political, social, legal, etc.) between Europe and the U.S., and it provides even stronger reasons why the U.S. would be affected more by the market activity in Europe.

In the multivariate regression portion of Table 4, the first six data columns show the results using the UK's FTSE to represent Europe and Japan's Nikkei 225 to represent the Asian-Pacific. Several European markets and/or several Asian-Pacific markets cannot be used in the same regression equation because of severe multicollinearity problems. The first row shows only the impact of the FTSE on the S&P 500 for 2005–2011 period. The coefficient is 0.64 and is highly significant. When the N 225 is added as an additional explanatory variable in the second row, the coefficient for FTSE rises slightly; however, the coefficient for N 225 is negative (–0.09) and significant. So, what happens is that the positive impact of N 225 in the bivariate regressions is completely overpowered by the positive impact of the FTSE, and N225 shows up as having a negative impact[14]. The third row shows the results if the sample of returns is limited to the days when the returns on the FTSE were either greater than one percent or less than negative one percent. The absolute value of each coefficient rises slightly, compared to the previous equation that included all daily returns. The last two rows show the results for 2000–2004 period. The coefficients for FTSE are smaller than they are for 2005–2011 period. The coefficient for N 225 is not significant.

In an attempt to incorporate a wider group of markets in this estimation, a European market return index and an Asian-Pacific return index are created. This is done by creating a measure of weighted average returns for each region, where the weights are based on the stock market total capitalization in each country. Six largest Asian-Pacific markets and three European markets shown in Table 4 were used to create these return indices[15]. For 2005–2011 period, the 2007 market capitalizations were used to create the return indices, and for 2000–2004 period, the 2002 market capitalizations were used[16]. The last six columns of the multivariate regression section of Table 4 provide these estimations. While the coefficients and *R*-squared values rise compared to the estimates that use FTSE and N 225, the results are very similar.

To summarize the results shown in Table 4, it appears that the same day impact of the Asian-Pacific market returns on the S&P 500 returns is far less than the impact of the S&P 500 returns on the next day Asian-Pacific returns. The results shown in Table 4 are mixed, with the bivariate regressions suggesting some positive impact and the multivariate regression estimations suggesting little or no impact. If we place more confidence in the multivariate model, the empirical findings do not reject Hypothesis 3 that U.S. equity daily returns are not affected by Asian-Pacific equity market daily returns. These results support the findings of Becker, Finnerty, and Gupta (1990) and Arshanapalli and Doukas (1993) that the Japanese market has no influence on the U.S. market, and the findings are contrary to those of Wei, Liu, Yang, and Chaung (1995) that the Tokyo market has some influence on the New York market.

3.1.3. Up-day versus down-day returns – asymmetries in returns

Since previous studies have shown a stronger reaction in foreign markets to negative U.S. returns (compared to positive returns), it will be informative to see if this extends to daily returns for the periods and countries used in this study. Table 5 disaggregates the returns into up-day and down-day returns for the entire period for each index and for the single period from 2005 to 2011. Table 5 shows that all the down-day foreign market reactions are stronger (and all are statistically significant) than the up-day reactions (many of which are not statistically significant) for both the full period and 2005–2011 period. This supports the work of Koutmos and Booth (1995) and Kolluri, Machuga, and Wahab (2014), and is the opposite of the findings of Becker, Finnerty, and Tucker (1992).

A comparison of the 2005–2011 numbers in Tables 3 and 5 suggests that the numbers in Table 3 may be somewhat deceiving. This is because when both the up- and down-market days are included in the same regression (as in Table 3), the result is an "average" relationship across both subsets, even though each subset can exhibit a different foreign market index reaction to the S&P 500 index. For example, in Table 3, the regression coefficient (or beta) for the Nikkei 225 is 0.64 for 2005–2011 pe-

Table 5. Regression coefficients for regressing the foreign index on the S&P 500 index [e.g., Nikkei $225_{t+1} = f(\text{S\&P } 500_t)$]

Abbrev.	Index	Years	For the full period of the index returns						2005–2011							
			Change of 1% or more			Change of –1% or less			Change of +1% or more				Change of –1% or less			
			Coeff.	*t*-stat	N	Coeff.	*t*-stat	N	Coeff.	*t*-stat	R^2	N	Coeff.	*t*-stat	R^2	N
^N225	Nikkei 225	1984–2011	0.48	8.86	955	0.59	11.52	857	0.42	5.07	0.09	262	0.72	9.07	0.23	275
^HSIX	Hang Seng	1987–2011	0.56	7.24	875	0.63	9.48	813	0.34	3.30	0.04	264	0.58	5.42	0.10	280
^STI	Straits Times	1988–2011	0.33	5.65	831	0.53	9.88	777	0.23	2.67	0.03	260	0.32	4.16	0.06	276
^AORD	All Ordinaries	1984–2011	0.35	10.61	959	0.58	16.88	866	0.32	5.16	0.09	267	0.49	8.60	0.21	282
^NZ50	New Zealand Exch 50	2004–2011	0.23	6.48	274	0.38	12.04	287	0.23	6.36	0.13	264	0.38	11.65	0.33	274
^KS11	Kospi Composite	1997–2011	0.34	3.74	593	0.56	6.80	601	0.13	1.44	0.01	259	0.53	5.86	0.11	279
^TWII	Taiwan Comp. (Wtd)	1997–2011	0.25	4.27	595	0.38	6.15	594	0.24	3.11	0.04	262	0.35	4.78	0.08	274
^JKSE	Jakarta Composite	1997–2011	0.12	1.59	594	0.56	8.33	581	0.20	2.20	0.02	256	0.46	5.48	0.10	268
^KLSE	FTSE Malaysia	1995–2011	0.18	2.54	666	0.38	8.21	643	0.00	0.02	0.00	260	0.21	5.21	0.09	272
^THDOWD	Dow Jones Thailand	2000–2011	0.13	1.65	474	0.35	5.16	504	0.05	0.54	0.00	256	0.28	3.30	0.04	274
^SSEC	Shanghai Composite	2000–2011	0.10	1.39	453	0.27	3.92	487	0.12	1.15	0.01	253	0.27	3.03	0.03	272
^BSESN	Bombay SENSEX	1997–2011	0.06	0.73	610	0.35	4.87	602	0.04	0.37	0.00	267	0.23	2.28	0.02	274
^FTSE	FTSE 100	1984–2011	0.23	5.09	961	0.29	6.27	867	0.26	3.07	0.03	263	0.26	3.42	0.04	279
^GDAXI	DAX	1990–2011	0.08	1.24	748	0.24	3.37	701	0.16	1.76	0.01	265	0.18	1.95	0.01	281
^FCHI	CAC40	1990–2011	0.23	3.85	771	0.27	4.13	738	0.22	2.26	0.02	267	0.23	2.55	0.02	282

riod, while in Table 5, the beta for positive return days is 0.42 and for negative return days is 0.72.

Looking at the reaction of the Australian index daily returns compared to the S&P 500 daily returns, the estimated coefficient in Table 3 for 2005–2011 is 0.50 (and is highly significant), and the *R*-square of the equation is 0.50. In Table 5, the coefficients are 0.32 and 0.49 (and are statistically significant) for positive and negative change days; and the *R*-square is 0.09 and 0.21. Thus, the coefficients for AORD in Table 5 are both lower than the coefficient in Table 3 for the combined regression, and the *R*-square of both equations is far below that shown in Table 3.

Finally, looking at South Korea's KS11 index, the coefficient in Table 3 for 2005–2011 is 0.42 (and significant), and the *R*-square is 0.24. However, the results in Table 5 show that the positive return coefficient (0.13) is insignificant with *R*-square of 0.01, and the negative return coefficient is 0.53 (and significant) with an *R*-square of 0.11. The coefficient for negative changes from Table 5 is higher than the combined sample coefficient in Table 3.

To sum up the Table 5 findings, the down-market reactions are stronger than the up-market reactions in all the Asian-Pacific markets. For 2005-2011 the average coefficient in down-markets for the eleven Asia-Pacific nations is 0.42, exactly double the coefficient of 0.21 in up-markets. Thus, Hypothesis 4 (that the upward moves in Asian-Pacific equity markets following a move up in U.S. equity markets are symmetric to the downward moves in these markets) may be rejected. Compared to the "average" reaction to all changes shown in Table 3 for 2005–2011, the reactions to positive changes shown in Table 5 are all far lower and the reaction to negative changes show a mix of higher and lower values.

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CONCLUSION

This paper looks primarily at daily movements of several Asian-Pacific equity markets compared to the S&P 500 index using the data that are freely available online to all investors on *Yahoo! Finance*. The findings are informative for investment management professionals in several ways. The regression models show that the Asian-Pacific equity markets are influenced by the returns in U.S. equity markets, having strong positive and significant "betas" when their returns are regressed against the S&P 500 returns. The daily return analysis shows that investment managers should pay close attention to large U.S. daily price movements, particularly their impact on more mature Asian markets that tend to react more strongly to large U.S. daily price changes. However, each of the eleven Asian-Pacific markets moves differently in response to changes in the U.S. market, and the stability of the relationship over time varies from market to market. All of the Asian-Pacific equity indices exhibit asymmetries with the S&P 500 index, where the reactions to U.S. changes are far stronger (about double in the 2005-2011 period) on negative return days relative to positive return days.

This research suggests several policy implications for investors. First, investors in Asian equities should keep a close eye on the U.S. market due to the rapid transmission of large market changes, especially negative changes. Second, the developed equity markets (Japan, Hong Kong, South Korea, and Australia in the 2005-2011 period) tend to react more strongly to U.S. equity market changes than do less mature equity markets in Asia. Third, the reaction to U.S. equity movements not only varies from country to country but also varies across time. The variability across time is especially noticeable for the equity markets in Indonesia and Malaysia. Finally, those trying to build a diversified portfolio should realize that many of the observed past relationships between specific countries are not stable going into the future and that diversification will not help as much in down markets.

ENDNOTES

1. This paper focuses on how returns in various markets are related, not prices. Several previous studies have conducted a time series analysis of price movements in equity markets. However, looking at price movements is not the same as looking at returns. For example, using the S&P 500 U.S. index compared to the All Ordinaries Australian index, the correlation of daily prices was 0.883 for 2005–2011 and the correlation of returns was 0.606. These same numbers for 2000–2004 were .300 and .585.

2. For example, for 2005–2011 period, used in this study, out of possible 1,763 trading days for the S&P 500 index, there were only about 550 trading days that had returns greater than +/–1%. Besides, the sample size is reduced even more and by different amounts as holidays are considered in each country.

3. They say that the U.S. market affects Asian and European markets with a "one-day lag," but it is actually just a few hours difference. Thus, the U.S. market's impact on the rest of the world should be considered "same day," not a one-day lag.

4. This is an interesting point, but there is no empirical evidence provided to support it. In the case of Japan, how many stocks have not traded at the opening? And which stocks account for the majority of the change in the index during the first hour of trading? Many stocks may change in value over the course of the first hour of trading due to fundamental reasons, meaning that the change in the first hour is only partially explained by a "sticky" opening.

5. They handle holidays by deleting data from the sample if any of the four countries has a holiday, so they have 371 data points for all four countries from 1-2-97 through 4-30-98. This, however, cannot

be the case, because the number of trading days in the U.S. market for these dates is only 335. If additional trading days are deleted due to Japanese and Chinese holidays, the sample size should be well below 335. The only way to get to a sample size of 371 is to expand the time period by 2 or 3 months.

6. Many researchers mistakenly focus solely on correlation of returns, including Coeurdacier and Guiland (2011). They state that: "…investors…hedge their exposure to domestic risk by holding foreign equities that have low correlations with their own stocks." However, a foreign equity with a low correlation and high variance is not a good diversifier, because its covariance risk may be high. It is covariance that is a true measure of an asset's risk, not correlation. The correlation is just one determinant of covariance as indicated by the formula $Cov_{ij} = Corr_{ij}$ x StdDev_i x StdDev_j. So, in a capital asset pricing model framework, if an investor is adding foreign asset "X" to a domestic portfolio "M", the relevant measure of risk is $Corr_{XM}$ x StdDev_X, not simply as $Corr_{XM}$.

7. Month-end closing prices in non-U.S. markets are not used, because we do not want to compare U.S. equity market returns to foreign market returns that were established earlier on the same day. If this is done correlation coefficients are somewhat lower, on average.

8. In other words, if the foreign market was not open on Thursday, the S&P price is deleted from the sample for Wednesday. The foreign market return for Wednesday through Friday is matched with the S&P 500 return for Tuesday through Thursday.

9. Because of the data deletions due to holidays, the sample sizes are different when comparing the S&P 500 returns with individual country index returns. While in 2005–2011 period there were 1,763 S&P 500 trading days, the sample for the AORD $\text{Return}_{t+1} = f(\text{S\&P 500 Return}_t)$ estimate was reduced by 35 observations due to holidays and the sample for the SSEC $\text{Return}_{t+1} = f(\text{S\&P 500 Return}_t)$ estimate was reduced by 120 observations (because of the larger number of holidays in China).

10. There are several considerations that affect which market index to use in estimating beta, such as the portfolio constraints under which the portfolio manager operates. For many, an index of the world portfolio may be a superior measure. However, the intention is to focus on the foreign index reaction to the U.S. market, and the S&P 500 index is probably the most-used U.S. index for calculating betas. Also, the use of 5 to 7 years of monthly data is the standard methodology for calculating the betas for stocks, mutual funds, and ETFs.

11. The coefficient estimates are not real beta estimates, because only a subset (large changes) of the total daily data is used in the estimates. Also, betas are rarely estimated using daily return data, because there is too much noise (very small insignificant changes) in the data. That is why only large daily changes in the S&P 500 index are used in the estimates.

12. Because daily returns include a lot of small returns that are simply "noise," the intent is to filter out small changes. Statistical tests showed that moving to a filter of +/–1% or greater was a suitable filter, whereas a larger filter reduced the sample size too much. For 2005–2011 period, this resulted in a sample of about 260 days for +1% or higher returns and about 275 days for –1% or lower returns out of 1,763 trading days.

13. The lower "daily betas" – relative to "monthly" betas – are most likely due to the impact of non-synchronous trading as pointed out by Dimson (1979) and Reilly and Wright (1988). In this case, the Asian-Pacific indexes may be composed of many stocks that may not trade continuously right up to the close of the trading day.

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14. What this suggests is that multiple regression analysis is not the appropriate method to use to measure the impact of the Nikkei 225 on the S&P 500. A better way to measure the impact of the N 225 would be to use a simultaneous estimation procedure or two-stage least squares. We do not pursue this further and will leave it to future researchers.

15. In 2012, the six largest Asian-Pacific stock markets contained about 87 percent of the total Asian-Pacific market capitalization, so leaving out the other five smaller markets has little impact on the index.

16. For example, for the 2009–2011 period, the weights were .35, .14, .07, .05, .09, and .30, for N 225, HSI, AORD, KS11, TWII, and SSEC, respectively; and were .42, .25, and .34, for FTSE, GDAXI, and FCHI.

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