

**THE EFFECTS OF EXCHANGE RATE CHANGES ON THE CO-MOVEMENT  
OF EQUITY MARKETS**

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## **Abstract**

This paper analyzes the co-movement of the US equity market and 10 markets in Asia and Oceania (i.e., referred to as domestic markets). We find that the daily returns of the ten emerging markets are significantly correlated with the performance of US market in the previous trading day. Also, we analyze the contemporaneous change in the US/domestic market exchange rate, and how it affects this co-movement. We find that the correlation between the US market and domestic markets is positively related to the net-trade balance that exists between these countries. Countries that tend to net-export to the US are affected more positively by the strengthening of the US dollar compared to the domestic currency.

**Keywords:** equity market; exchange rate; trading balance of GDP

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## Glossary

WRDS	Wharton Research Data Services
AUD	Australian Dollar
CNY	Chinese Yuan
HKD	Hong Kong Dollar
INR	Indian Rupee
JPY	Japanese Yen
KRW	South Korean Won
MYR	Malaysian Ringgit
NZD	New Zealand Dollar
SGD	Singapore Dollar
THB	Thai Baht
USD	US Dollar
OLS	Ordinary Linear Squares
GDP	Gross Domestic Product



# 1. Introduction

Globalization has made the interdependence amongst countries higher than any era in human history. Also, the development of technologies has increased the speed in which information is spread in the world. The financial crisis is an example that shows how interdependent the world has become. The eruption of the subprime crisis in US market spread rather swiftly to the US equity markets, and this has been followed by a wave of similar movements across the globe. In this study, we try to get a better understanding of the determinants that affect the correlation between different equity markets.

The US equity market is the biggest and the most developed market in the world. It occupies about 40 percent of total equity markets value in the world<sup>1</sup>. Furthermore, the US market is considered the most developed and transparent market, as well as the most studied market. As such, it makes sense to start our understanding of the co-movement by analyzing the co-movement that exists between the US and other international markets. Hence, our first objective in this study is to analyze the degree of co-movement that exists between the US equity market, which we will consider as the first-mover, and 10 international markets that open after it closes (i.e., in the following trading day).

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<sup>1</sup> Source from: <http://www.visualcapitalist.com/all-of-the-worlds-stock-exchanges-by-size/>

The second objective of this paper is to analyze the effect of exchange rate changes. Every day, there are changes not only in the equity markets, but also in the currency market. Thus, changes in equity markets and currency markets occur simultaneously, and it is interesting to get a better understanding how changes in exchange-rates would affect this co-movement. On the one hand, if the US dollar appreciates compared to the domestic market, it suggests that the US economy has become stronger. All other things being equal, the systematic (world factors) should be appreciated in domestic market terms. Also, companies which are traded in the US market and the domestic market are worth more in domestic market terms, which should lead to a higher return in the domestic market. On the other hand, it seems that the exchange rate effect should greatly depend on the net-trade balance of the domestic companies. If the domestic country is a net-exporter, it seems that the domestic market gains from the appreciation of the US dollar, while the opposite is true if the domestic country is a net importer from the US. To check this hypothesis, we test whether the net-trade balance of the domestic country with the US affects positively the correlation between changes in the exchange rate and the following day returns in the domestic stock market.

## 2. Literature Review

As globalization developed, the capital markets, including equity markets and currency markets, tend to move together as well. Since United States held the leading position in financial markets around the world, studies tend to investigate the lead-lag relationship between United States and other equity markets. Cheung and Mak (1992) found that US market leads other developed markets and some of Asian emerging markets. More recently, a lot of scholars tested for the co-integration among various stock markets. Wong, Penn, Terrell, and Lim (2004) investigated whether investors could be benefit from international diversification. They found the co-movement between major developed markets of United States, United Kingdom and Japan with the emerging markets, including Malaysia, Thailand, Korea, Taiwan, Singapore, and Hong Kong. The correlation between those markets have limited the benefit of investment in different national equity markets.

Huang, Yang, Hu (2000) studied the causality and co-integration relationships among the stock markets of the United States, Japan and the South China Growth Triangle (SCGT) region. Through unit root test and Granger causality test, they found that US market has more impact on Hong Kong and Taiwan markets than Japan market. In addition, Hong Kong market is highly correlated with the US market.

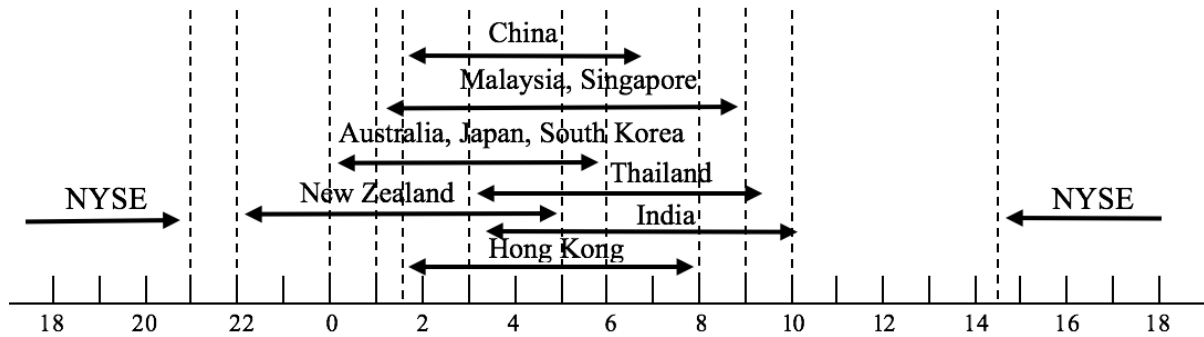
Pan, Fok, and Liu (2007) examined dynamic linkages between exchange rates and stock prices for seven East Asian countries, including Hong Kong, Japan, Korea, Malaysia, Singapore, Taiwan, and Thailand from January 1988 to October 1988. They used the Granger causality test to exam the relationship between equity market and currency market. The result shows, three countries which include Hong Kong, Korea, and Singapore, have

a causal relationship from equity market to currency market. More scholars verified the relationships between equity market and currency market. How the currency market affect equity market? Ma and Kao (1990) studies the stock price reactions to exchange rate changes. Based on their own model, they suggested that, for an export-oriented country, the currency appreciation of the domestic market reduces the competitiveness of export markets and has a negative effect on domestic stock market. Conversely, for an import-dominated country, the currency appreciation will lower import costs and generate a positive impact on the stock market.

The above did not analyze the relationship between equity market and currency market together, as both of them should affect the co-movement between the US and the domestic market. Thus, this paper analyzes the co-movement between the US and international markets in a framework that includes both changes in equity markets and the foreign exchange rates.

### 3. Sample Selection and Data Description

#### 3.1 Country Selection



**Figure 1 Time Zone and Trading.** The figure provides trading hours of the different markets in GMT. For example, NYSE trading hour starts 15 hours after midnight GMT, and ends 21 hours after GMT.

This paper analyzes the co-movement of equity markets around the world. We analyzed the co-movement of US market with ten markets that appear in Figure 1. The ten markets in Asia and Oceania areas were chosen not only because they do not have any overlap open hours with US markets, but also because they are very liquid.

Through this selection, we avoid the difficulty which would occur if there was simultaneous trade in both market. When markets trade simultaneously the information transmission is bi-directional, which makes statistical inference difficult. Also, all of those ten markets are located around Asia and Oceania area and have close political and economic relationships with US market, which will help us to get sufficient data and have more explanatory power in this paper.

### 3.2 Equity Markets Daily Return & Statistics

To measure the performance of each equity market, we used market-capitalization weighted indices with dividends from WRDS World Indices. We download the daily return with dividends of all ten equity markets, which is used in this paper to represent equity market performance. Since the report is aiming to analyze the effect of how the returns in the US market is correlated with the return on these other ten international markets, to these markets, we used the previous calendar day return for US market. Through WRDS, we collected the data from the beginning of 1990 to December 10<sup>th</sup>, 2015. However, the returns of Chinese equity markets start in 1994 and those of Hong Kong equity market start in 1993.

**Table 1** **Descriptive Statistics of Daily Return of Equity Markets.** *This table provides observation number, mean daily return, standard Deviation of daily return, minimum value and maximum value of daily returns.*

<i>Country</i>	<i>Observation</i>		<i>Standard</i>		
	<i>Number</i>	<i>Mean</i>	<i>Deviation</i>	<i>Min</i>	<i>Max</i>
Australia	6,319	0.0347%	0.9176%	-8.2187%	6.2972%
China	4,989	0.0560%	2.0423%	-15.5213%	33.7177%
Hong Kong	6,174	0.0526%	1.5890%	-13.0837%	16.3934%
India	5,916	0.0462%	1.6167%	-13.0341%	14.7416%
Japan	6,096	0.0067%	1.3319%	-9.5182%	13.3171%
South Korea	6,109	0.0294%	1.7757%	-11.7466%	11.9361%
Malaysia	6,154	0.0274%	1.2385%	-17.3832%	19.5758%
New Zealand	5,880	0.0433%	0.8660%	-13.0078%	10.3242%
Singapore	6,272	0.0266%	1.2113%	-8.8945%	12.9724%
Thailand	6,052	0.0233%	1.6267%	-15.1826%	18.1415%
United States	6,540	0.0335%	0.0140%	-9.0350%	11.5800%

Table 1 shows that the Chinese market has the least observation number, because China starts very late and thus has the least mature financial market among these eleven countries. The Chinese market also has the largest range of daily return. The Japanese market has the smallest mean. More importantly, US equity market has the smallest volatility according to standard deviation, implying that US equity market is the most stable.

### **3.3 Daily Return of Foreign Exchange Rate & Statistics**

To understand whether the movement of exchange rate could affect the performance of those equity markets. We used the daily returns of the exchange rate between local currency and US dollar. We collected the exchange rate from Federal Reserve Bank Reports in WRD. And then, the daily returns are calculated by the following equation:

$$Return = \ln \frac{Exchange\ Rate_t}{Exchange\ Rate_{t-1}}$$

where, *Exchange Rate* is the local currency of \$1 US Dollar, for example,

5.03 CNY/USD.

Since we were analyzing how the currency market affects equity market, we also used the previous day return of foreign exchange rate to analyze those emerging equity markets. The analysis was based on the exchange rate daily return between the beginning of 1990 to the ending of 2015.

Through data processing in Stata, we merged the return of exchange rate and the return of equity market for these countries by the existing trading day in the equity market for every country.

**Table 2 Descriptive Statistics of Daily Return of Exchange Rate.** *This table provides observation number, mean, standard Deviation, minimum value and the maximum value of daily returns of the exchange rate.*

<i>Currency</i> <i>(#/USD)</i>	<i>Observation</i> <i>Number</i>	<i>Mean</i>	<i>Standard</i> <i>Deviation</i>	<i>Min</i>	<i>Max</i>
AUD	6,319	0.0012%	0.7546%	-7.4190%	8.5639%
CNY	4,989	-0.0051%	0.0892%	-1.9984%	1.8327%
HKD	6,174	-0.0001%	0.0338%	-0.4512%	0.4120%
INR	5,916	0.0197%	0.4804%	-3.6863%	10.6706%
JPY	6,096	-0.0012%	0.6811%	-5.4747%	3.3993%
KRW	6,109	0.0095%	0.8113%	-17.9292%	14.6199%
MYR	6,154	0.0105%	0.5011%	-8.7500%	7.4609%
NZD	5,880	0.0027%	0.7718%	-5.7555%	5.7779%
SGD	6,272	-0.0028%	0.3521%	-4.0597%	2.8003%
THB	6,052	0.0090%	0.6179%	-6.1556%	23.0832%

Table 2 shows that the mean of foreign exchange rate is much smaller than that of equity market return. However, the standard deviation is only about half than that of equity market. This should not be surprising, exchange rate can either increase or decrease, while prices of equity markets should on average increase (compensation for risk). Overall, the fact that standard deviation of exchange rate is so high, suggests that it is an important factor to consider in the study of co-movement. Moreover, Hong Kong dollar has the least standard deviation because of its linked exchange rate system with USD.

### 3.4 Trading Balance to GDP Ratio

The paper used the quarterly trading balance to GDP ratio to analyze the relationship between trading balance and the coefficient of the exchange rate in the co-movement equation. However, we are only able to find a very short period data for India GDP in USD.



Therefore, India is excluded in this part of the analysis. Also, three countries had missing data in some of the years. The data for China is from 1992 to 2015; Thailand is from 1993 to 2015 and Malaysia is from 1991 to 2015. Rest of the countries have full data from the beginning of 1990 to the end of 2015.

We downloaded the US monthly trading data with partner country from United States Census Bureau Website and (quarterly data from 1990 to 2015), and quarterly countries GDP in USD for every country from Bloomberg. We then calculated the quarterly trading balance to GDP as the following equation:

$$\text{Trading Balance to GDP} = \frac{\text{Export to US} - \text{Import from US}}{\text{GDP in USD}}$$

where, *Export to the US* is the import amount from the partner country from US perspective;

*Import from the US* is the export amount to the partner country from US perspective;

## 4. Methodology

### 4.1 Linear Regression

This paper uses a simple linear regression and a two-factor linear regression. And the robust regression method is used to estimate the parameters in regression models, with aiming to minimize the difference between given dependent data and predicted number under linear regression and eliminate the influence of outliers.

Simple linear regression means that there is only one independent variable to explain dependent variable. To analyze the single effect of US equity market on other equity markets in the following day, we used simple linear regression here. The formula is as follows:

$$\begin{aligned} & \textit{Equity Index Return}_{\textit{Domestic Country},t} \\ &= \alpha + \beta_1 \textit{Equity Index Return}_{US,t-1} + \varepsilon_t \end{aligned}$$

where, domestic countries include Australia, China, Hong Kong, India, Japan, South Korea, Malaysia, New Zealand, Singapore, and Thailand,

Also, we analyzed how exchange rate change affects the performance of the nine emerging markets. To do the analyze, we added the exchange rate return as one of the variables. Since we used the USD market exchange rate, we used lag one data. We run a regression for the following equation to analyze this question:

$$\begin{aligned}
& \mathbf{Equity\ Index\ Return}_{Domestic\ Country,t} \\
& = \alpha + \beta_1 \mathbf{Equity\ Index\ Return}_{US,t-1} \\
& + \beta_2 \mathbf{Exchange\ Rate\ Return}_{t-1} + \varepsilon_t
\end{aligned}$$

Where, *Exchange Rate Return* is the daily return of exchange rate, the amount of domestic currency of \$1 USD.

The regressions are run for each country, so we have ## pairs of  $\beta_1$  and  $\beta_2$  coefficient. We also run regressions for different countries in every quarter from 1990 to 2015, the result of which could be used to match the quarterly trading balance to GDP group. Thus, we use the trade-balance that is known to investors trading in the market.

## 4.2 Two-sample T-test

To test whether the coefficient of the exchange rate in the regression model is different between two groups, the two-sample t-test is used to verify whether the two sample means are equal under some confidence level. The hypothesis of two-sample t-test is as follows:

$$Null\ Hypothesis\ H_0: \mu_1 - \mu_2 = 0$$

$$Alternative\ Hypothesis\ H_a: \mu_1 - \mu_2 \neq 0$$

where,  $\mu_1, \mu_2$  are the population mean of two tested groups in Section 5.3

The test statistic formula is:

$$T = \frac{\sigma_1 - \sigma_2}{\sqrt{\frac{s_1^2}{N_1} + \frac{s_2^2}{N_2}}}$$

where  $\sigma_1, \sigma_2$ , are the sample means,  $s_1, s_2$  are the sample standard deviations

and  $N_1, N_2$  are the sample sizes

Assume the confidence level is  $\alpha$ ,

if  $|T| > t_{\alpha/2, df}$ ,

where,  $df$ , the degree of freedom =  $N_1 + N_2 - 2$

Then we can reject the null hypothesis that two population means are equal. Otherwise, we cannot reject.

Based on quarterly trading balance to GDP, we separated the coefficient of the exchange rate in second equation into four groups, where group 1 is the group with the lowest trading balance and group 4 is that with the highest trading balance. The partitioning to groups is done every year. Then, we used a two-sample t-test to verify the difference in coefficient of the exchange rate between group1 and group2, group2 and group3, and group3 and group4.

## 5. Empirical Results

### 5.1 Effect of US Equity Market on Other Equity Markets

Table 3 provides regression results of the co-movement of the US market and the ten domestic markets.

**Table 3** Co-movement of US market and domestic markets. *The table provides country level regression results of the following form:  $Equity\ Index\ Return_{domestic\ country,t} = \alpha + \beta_1 Equity\ Index\ Return_{US,t-1} + \varepsilon_t$ . Standard deviations are provided in parenthesis, \*, \*\*, \*\*\* corresponds to statistical significant at the 10, 5, 1 percent level, respectively.*

Country	Observation Number	US return [lag1]	t-statistics	Constant	Adj. R- squared
Australia	6,319	0.417*** (0.0155)	26.88	0.000216** (9.93e-05)	0.268
China	4,989	0.143*** (0.0259)	5.53	0.000512* (0.000288)	0.007
Hong Kong	6,174	0.526*** (0.0280)	18.80	0.000356* (0.000188)	0.141
India	5,916	0.375*** (0.0246)	15.21	0.000344* (0.000203)	0.070
Japan	6,096	0.489*** (0.0217)	22.48	-8.49e-05 (0.000155)	0.175
South Korea	6,109	0.431*** (0.0289)	14.91	0.000146 (0.000219)	0.077
Malaysia	6,154	0.286*** (0.0194)	14.69	0.000199 (0.000152)	0.069
New Zealand	5,880	0.306*** (0.0158)	19.39	0.000330*** (0.000104)	0.164
Singapore	6,272	0.354*** (0.0210)	16.87	0.000163 (0.000145)	0.109
Thailand	6,052	0.343*** (0.0254)	13.49	0.000134 (0.000203)	0.057

Table 3 shows that the t-statistics of the coefficient of US equity market daily return are all larger than 1.96, the z-value under 95% confidence level, implying that we can reject the

null hypothesis that the coefficient equals zero. In other words, the daily return of US equity markets in the previous day significantly correlates the other ten equity markets. What's more, the coefficient of US equity market return is all positive, which means that the change of US market and each emerging market moves in the same direction. According to adjusted R square, representing the goodness of fit for regressions, Australian equity market has the highest correlation coefficient with US market, while Chinese equity market has the lowest. We believe that the reason for the lowest correlation between Chinese market and US market is different economic and political structure.

## 5.2 Joint Effect of US Equity Market and Currency Market

Also, we analyzed how exchange rate change affects the performance of the ten emerging markets. To analyze the effect, we added the exchange rate return as one of the independent variables. Because we used the USD market exchange rate, the exchange rate return should be lag one data as well.

**Table 4 Two-Factor Linear Regression Result.** *The table provides country level regression results of the following form:  $Equity\ Index\ Return_{domestic\ country,t} = \alpha + \beta_1 Equity\ Index\ Return_{US,t-1} + \beta_2 Exchange\ Rate\ Return_{t-1} + \varepsilon_t$ . Standard deviations are provided in parenthesis, \*, \*\*, \*\*\* corresponds to statistical significant at the 10, 5, 1 percent level, respectively.*

Country	US return		Exchange Rate return		Constant	Adj. R-squared
	[lag1]	t-statistics	[lag1]	t-statistics		
Australia	0.413*** (0.0155)	26.56	-0.0358 (0.0219)	-1.63	0.000218** (9.93e-05)	0.268
China	0.144*** (0.0259)	5.54	0.190 (0.285)	0.67	0.000522* (0.000289)	0.007
Hong Kong	0.525*** (0.0280)	18.74	-1.080 (0.724)	-1.49	0.000355* (0.000187)	0.142
India	0.367*** (0.0248)	14.81	-0.163*** (0.0445)	-3.67	0.000378* (0.000202)	0.073

Japan	0.480*** (0.0223)	21.57	0.118*** (0.0304)	3.88	-8.09e-05 (0.000155)	0.179
South Korea	0.427*** (0.0289)	14.77	-0.0619 (0.0568)	-1.09	0.000153 (0.000219)	0.078
Malaysia	0.279*** (0.0193)	14.44	-0.191** (0.0897)	-2.13	0.000221 (0.000152)	0.075
New Zealand	0.309*** (0.0160)	19.29	0.0304** (0.0144)	2.12	0.000328*** (0.000104)	0.164
Singapore	0.348*** (0.0213)	16.37	-0.139** (0.0657)	-2.12	0.000161 (0.000144)	0.111
Thailand	0.342*** (0.0255)	13.40	-0.0669 (0.0863)	-0.77	0.000141 (0.000203)	0.058

As we can see from Table 4, the previous day return of US equity market is still positively significant correlated with the ten emerging equity markets under 95% confidence level, because the t-statistics are all more than 1.96. For example, if the US equity market increases in the previous day, the other ten markets will increase as well in next day, not decrease. As to t-statistics of Exchange rate return on a previous day, all are larger than 1.96 except for China and Hong Kong. Thus, the effects of foreign exchange rate return of five countries have a significant impact on their equity markets. However, the sign is different – it seems that most countries are negatively affected by a strong dollar, except for New Zealand and Japan. This calls for further investigation.

In this part, we did the two-factor regressions for each country from 1990 to 2015. In order to match the quarterly trading balance data in the following two-sample t-test, we ran the two-factor regressions for each country at quarterly base.

### 5.3 Coefficients of Exchange Rate Differ Based on Trading Balance with the US

From the two-factor linear regression result in Table 4, we find that the coefficient is negative for three countries, positive for two. Overall, it seems that a stronger dollar is negatively related to domestic stock market changes, but there is significant variation across countries. We next hypothesize that the correlation coefficients of exchange rate daily return differ based on the trading balance of the country with the US. A stronger US dollar should benefit net exporters but should have a negative effect on economics who are net importers from the US.



**Figure 2 Group Criteria.** *The figure provides the criteria of groups. Group 1 are those with lowest trade balance to GDP (highest net importer) and Group 4 are those with highest trade balance to GDP (highest net export).*

To test this hypothesis, we separated the countries each year, to four groups based on their trading balance with United States (normalized by GDP of the domestic country).

We used three proxies for trade balance: current quarter trading balance with the US, previous quarter trading balance with US and average of previous four-quarter trading balance with the US. All trading balance measures are normalized by GDP of the domestic country. We then did the two-sample t-test based on different groups.



**Table 5 Two-Sample T-test Results in Three Panels.** *These three tables provide the mean and standard error of coefficients on the exchange rate, and the two-sample t-statistics between adjacent groups, by using the quarter trade balance with the US, which is normalized by GDP of the domestic country. Standard deviations are provided in parenthesis, \*, \*\*, \*\*\* corresponds to statistical significant at the 10, 5, 1 percent level, respectively.*

**Panel A: by Current Quarter Trading Balance with the US**

Group	Observation Number	Coefficient on Exchange Rate	Standard Error	Two-sample T-statistics with previous group
1	224	-0.749162	0.335196	N/A
2	222	-0.259111	0.160688	-1.3146
3	223	0.399665	0.373909	-1.6162
4	221	1.892368	0.667254	-1.9561*
1	224	-0.749162	0.335196	-3.5517***

**Panel B: by Previous Quarter Trading Balance with the US**

Group	Observation Number	Coefficient on Exchange Rate	Standard Error	Two-sample T-statistics with previous group
1	222	-1.10724	0.361346	N/A
2	220	0.0699663	0.0775568	-3.1721***
3	222	1.078919	0.4874282	-2.0354**
4	219	1.288231	0.5986044	-0.2715
1	222	-1.10724	0.361346	-3.4367***

**Panel C: by An Average of Four Previous Quarter Trading Balance with the US**

Group	Observation Number	Coefficient on Exchange Rate	Standard Error	Two-sample T-statistics with previous group
1	217	-1.060862	0.3753292	N/A
2	215	-0.0244635	0.048692	-2.7261***
3	216	0.9468367	0.496326	-1.9432*
4	214	1.518593	0.6145631	-0.7245
1	217	-1.060862	0.3753292	-3.5933***

From Panel A, the first two groups have a negative coefficient of the exchange rate, and the other two groups have positive coefficient. There are a few takeaways. First, there is a clear ordering: the coefficient becomes larger the higher the trade balance (the more net exporter the country). Because group 1 has lowest net export with US and group 4 has highest net export with the US, if USD appreciates, it benefits group 4 and harms group 1, so the equity market seems to be affected correspondingly. Moreover, the absolute value of two-sample t-statistics become larger and closer to 1.96. Thus, the null hypothesis between group 3 and 4 can be rejected. To let the results clearer, we also compared group 1 and 4, and the absolute value of t-statistic is 3.5517, much higher than 1.96, indicating that we can reject the null hypothesis and that export-oriented country and import-oriented country could have opposite effect of exchange rate on domestic equity market.

Though Panel A provides results consistent with our hypothesis, we conduct a similar analysis by using previous quarter trading balance with the US. In reality, trader have knowledge of the trading balance in the previous quarter, so it may be a better proxy for the exchange rate effect. Thus, theoretically, the previous quarter trading balance with the US should have stronger explanatory power.

From Panel B, only group 1 has a negative coefficient of the exchange rate. Two-sample t-statistics between group 1 and group 2, between group 2 and group 3 are larger than 1.96, implying that the means of each two groups are different at 95% confidence level. Also, the t-test result between group 1 and 4 is -3.4367, implying that we can reject the null

hypothesis. Thus, the different trading balance with the US should have an impact on the coefficient of the exchange rate in regression.

Additionally, we tried the third method to separate into groups by using average of four previous quarter trading balance. Same as Panel A, in Panel C, the first two groups have a negative the coefficient of exchange rate, and the other two groups have positive coefficient. The absolute value of two-sample t-statistic between group 1 and group 2 is largest and is the only one larger than 1.96. Here, group 1 is more like as domestic-oriented group and group 2 is close to the export-oriented group. Thus, the result in Panel C makes sense as well, indicating that markets will react to the average of previous four trading balance with the US. Overall, the results of table 5 (including all three panels) are consistent with our hypothesis.

## 6. Conclusion

Based on the result, we could get the following conclusions regarding the co-movement between US market and the ten emerging markets. First of all, the performance of those chosen emerging equity markets correlated with US equity market. We found out that daily return of US market is a significant factor that explains the daily return of the ten markets selected. Especially, it seems that the co-movement with the US is largest for Hong Kong, Japan, Australia market, and South Korea. The correlations between the daily return of American market and the following day returns of those market is higher than forty percent. We believe the reason is that those country or area have similar economic and political structure with the United States.

The main contribution of the paper, is the analysis of how exchange rate changes affects the co-movement between the US and the domestic markets. We find out that the trading balance with the US affects the correlation coefficient between exchange rate returns and domestic market equity returns. A stronger US dollar benefits the countries who comparatively have a trade surplus with the US. It thus seems to positively influence the performance of domestic equity market. On the other hand, a stronger US dollar could have a negative effect on those countries which highly rely on the import from the US. Therefore, a stronger US dollar seems to negatively affect these countries equity market.

# Appendices

## Appendix A (Stata Do-file Code)

```
* Country  CountryCode
* Australia  1
* China     2
* Hong Kong  3
* India     4
* Japan     5
* South Korea 6
* Malaysia  7
* New Zealand 8
* Singapore 9
* Thailand  10

* Data Period: 1990 to 2015

* Regression Model: other country index(t) = alpha + beta1*US index(t-1) + beta2*exchange rate(t-1)

*****
* Step 1: import other country indices & save dta file
import excel "/Users/moli/Downloads/20171114/other countries indices 20171110.xlsx", sheet("WRDS") cellrange(B1:G62219) firstrow clear

drop Date CountryName Currencyofstockprices

saveold "/Users/moli/Downloads/20171114/wholedata20171114.dta", version(13)

* Step 2: import US index & save dta file
import excel "/Users/moli/Downloads/20171114/us index return 20171110.xlsx", sheet("Sheet1") cellrange(A1:C7036) firstrow clear

drop US

saveold "/Users/moli/Downloads/20171114/usindex20171114.dta", version(13)

* Step 3: import exchange rate & save dta file

import excel "/Users/moli/Downloads/20171114/exchange rate adjusted 20171110.xlsx", sheet("Sheet1") cellrange(C1:E69790) firstrow clear

rename CountryCode countrycode

saveold "/Users/moli/Downloads/20171114/exchangerate20171114.dta", version(13)

* Step 4: Merge all data
use "/Users/moli/Downloads/20171114/wholedata20171114.dta"

merge m:m countrycode date using /Users/moli/Downloads/20171114/exchangerate20171114.dta
keep if _merge==3
drop _merge

sort countrycode date

merge m:m countrycode date using /Users/moli/Downloads/20171114/usindex20171114.dta
keep if _merge==3
drop _merge

sort countrycode date

drop if exchretlag1==.

* Step 5: Generate New variable "Year"
gen year = year(date)

* Step 6: Regress and Output data
statsby _b _se e(r2_a), by(countrycode) saving(/Users/moli/Downloads/20171114/resultbycountry.dta, replace):
regress DailyCountryReturnwithDivide usreturnlag1 exchretlag1, robust
statsby _b _se e(r2_a), by(countrycode year quarter) saving(/Users/moli/Downloads/20171114/resultbycountryandyear.dta, replace):
regress DailyCountryReturnwithDivide usreturnlag1 exchretlag1, robust
```

```

* Step 7: Analyze Regression by Country
use "/Users/moli/Downloads/20171114/resultbycountry.dta"

gen _t_value_usreturn = _b_usreturnlag1/_se_usreturnlag1
gen _t_value_exchret = _b_exchretlag1/_se_exchretlag1

saveold "/Users/moli/Downloads/20171114/resultbycountry.dta", replace version(13)

* Step 8: Import Trading Balance to GDP
import excel "/Users/moli/Downloads/20171114/WITS-Country-Trading balance.xlsx", sheet("Sheet4") cellrange(B1:D256) firstrow clear

rename year date

gen year = year(date)

saveold "/Users/moli/Downloads/20171114/tradebalancetogdp20171114.dta", version(13)

* Step 9: Merge "trading balance to GDP" with "Regression result by country and year"
use "/Users/moli/Downloads/20171114/resultbycountryandyear.dta"

merge m:m countrycode year quarter using /Users/moli/Downloads/20171114/tradebalancetogdp20171114.dta
keep if _merge==3
drop _merge

* Step 10: Separate the "trading balance to GDP" into 4 groups
gen highimport=0

forvalues i=1990(1)2015 {
xtile dimport=tradingbalanceofgdp if year==`i', nq(4)
replace highimport=dimport if year==`i'
drop dimport
}

* Step 11: Summarize coefficient of exchange rate and Drop outliers

forvalues i=1(1)10 {
sum _b_exchretlag1 if countr==`i', detail
replace _b_exchretlag1=r(p90) if countrycode==`i' & _b_exchretlag1>r(p90) & _b_exchretlag1~.
replace _b_exchretlag1=r(p10) if countrycode==`i' & _b_exchretlag1<r(p10)
}

*****You can run the code start from here with "result by country and year.dta" *****
* Step 12: using T-test to identify whether coefficient of exchangerate is different between 4 groups of trading balance to gdp
ttest _b_exchretlag1 if highimport==1 | highimport==2, by(highimport)
ttest _b_exchretlag1 if highimport==2 | highimport==3, by(highimport)
ttest _b_exchretlag1 if highimport==3 | highimport==4, by(highimport)
ttest _b_exchretlag1 if highimport==1 | highimport==4, by(highimport)

```

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