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Cointegration between stock prices and exchange rates in Asia-Pacific countries

Abstract

There is considerable interest surrounding the relationship between stock markets and exchange rates due to the potential predatory power for policy makers and investors. From a sample of seven Australasian countries, the authors find that there is no evidence of a long run cointegration between stock markets and exchange rates. This result interfaces with some of Bahmani-Oskooee and Sohrabian's (1992) and Nieh and Lee's (2001) findings, but contrasts to previous literature which suggests that there should be some cointegration relationship between the two markets (Lin, 2000). Although Japan shows some evidence of cointegration, Ramasay and Yeung (2005) suggest that such anomalies could merely be the product of the time period chosen, providing resolve to our conclusion that there is no long run significant relationship between stock markets and exchange rates.

Keywords: cointegration, stock prices, exchange rates, investments.

JEL Classification: G15.

Introduction

The relationship between stock markets and exchange rates has drawn the attention of investors and policy makers alike, mostly because they both play crucial roles in influencing the development of a country's economy (Nieh & Lee, 2001). This relationship has been utilized by fundamentalist investors and policy makers to predict the future trends for each other, and has been viewed as a valuable predatory tool. However, recent empirical studies (Bahmani-Oskooee & Sohrabian, 1992; Nieh & Lee, 2001; Ramasay & Yeung, 2005) have found that there is no long-run cointegration between the two variables.

Nonetheless, the relationship between stock markets and exchange rates continues to be a point of contention and topic for investigation. This paper utilizes a sample set of Asia Pacific countries, namely Australia, Hong Kong, Indonesia, Japan, New Zealand, South Korea and Thailand, from January 2006 to December 2008. New Zealand was the first country chosen, and others were selected according to the highest GDP and the presence of either linked system or free floating exchange rates. Unit root tests were then employed to test for stationary, and Engle and Granger's (1987) two-step methodology were used to test for cointegration.

Our empirical work rejects most of the previous studies that suggests there exists a significant cointegration between stock prices and exchange rates, which supports Bahmani-Oskooee and Sohrabian's (1992), Nieh and Lee's (2001) and Rahman and Udin (2009) findings regarding these two financial variables. However, Japan did show evidence of cointegration (Kurihara, 2006), but

Ramasay and Yeung (2005) suggest that this finding could be the result of the tests employed and time set chosen. Our findings also indicate some relationship between the stock market prices and exchange rates in the long run.

The remainder of this paper is organized as follows. Section 1 provides an overview of the literature revolving the topic. Section 2 describes our sample, listing the data and time sets chose. Section 3 presents the methodology and empirical findings, describing the tests used and their respective results. Section 4 discusses the findings of the study and the final section summarizes and concludes this paper.

1. Literature review

There has been a substantial amount of consideration given to the relationship between exchange rates and stock prices, particularly since numerous regimes have switched from primarily fixed to floating policies. "The efficacy of the flexible exchange rate system that has been in place since 1973 remains a point of contention, with some analysts questioning whether this system is functioning properly" (Whitt, 1989, p.18). Since then, numerous studies document a causal relationship between stock prices and exchange rates (Lin, 2000). However, more recent empirical evidence suggests that there is no long-run significant relationship between the two markets. Hence, information on market participants may not be useful to improve the forecast of another market (Rahman & Uddin, 2009) suggesting inefficiency in the market (Ibrahim, 2000).

"The literature on the relation between stock prices and exchange rates is very poor and includes few studies that have argued that exchange rate changes do affect stock prices" (Bahmani-Oskooee & Sohrabian, 1992, p. 459). However, the paper concludes with the

realization that although empirical results show that there is bidirectional causality between stock prices and the effective exchange rate, despite there being no long run relationship between the two variables. The Granger concept of causality, Akaike's final prediction error conjecture and the Chow-test were used to reveal this relationship (or lack thereof). Nieh and Lee (2001) also concluded that there was no significant relationship between stock prices and exchange rates in the G-7 countries, using both the Engle and Granger two-step methodology and Johansen maximum likelihood cointegration tests.

Ramasay and Yeung (2005) employed Granger causality methodology in a study between the two markets (exchange rates and stock markets) in nine east Asian economies. They found that "the direction of causality tends to demonstrate a hit-and-run behavior and switches according to the length of period chosen" (Ramasay & Yeung, 2005, p.162). The paper concludes with a cautionary note regarding the interpretation of Granger causality results, but the general result is the same; no long run relationship is found.

However, Hodrick (1990) argued that it is not so much the movement of either these two markets that particularly affects the other, but that it is the underlying economic fundamentals. For the stock markets, these include future dividends and discount rates. He argues that the "determination of market fundamentals for exchange rates requires general equilibrium considerations since exchange rates play many roles in the economy...the demand for and supply of money are particularly important" (Hodrick, 1990, p. 186). The notion that macro-economic fundamentals are key determinants in stock market and exchange rate fluctuations has long been an accepted truth. This is especially true when domestic prices in the country are strongly influenced by the corresponding exchange rates of trade (Yau & Nieh, 2009).

Amidst empirical studies, Meese and Rogoff (1983), Wolff (1988), Bailie and Selover (1987), Gharthey (1998), Nieh & Lee (2001) and Udoh, Akpan, John and Patrick (2012), all found relationships among macro-fundamentals and exchange rates. Empirical evidence for the relationships among macro-fundamentals and stock prices can be found in Bailey (1990), Sadeghi (1992), Kwon and Shin (1999). The point of difference between these and Hodrick (1990) is that Hodrick suggests that since these countries' fundamentals are drawn from the same foundation, that perhaps the illusion of a relationship between stock markets and exchange rates is merely the product of their underlying influences sharing the same origin. This notion could be supported by the growing amount of

literature professing the lack of evidence for a long-run relationship between the two markets. However, there is still the possibility that it is the choice of sample countries and time periods chosen that is producing these results; therefore, investigation into whether or not there is evidence of cointegration between stock markets and exchange rates continues.

2. Data and methodology

Our data consists of New Zealand and Australia, as well as the top five countries in the Asia-Pacific region, according to GDP. This includes Japan, South Korea, Indonesia, Thailand and Hong Kong, where China and Taiwan were excluded due to the currency not being free floating. The period for the data collection is from the year 2006 to 2008. Stock price indices were selected for each country and data obtained through DataStream.

Table 1. List of countries, stock market indices and currencies

Country	Index	Currency
New Zealand	NZX50	New Zealand dollar
Hong Kong	Hang Seng	Hong Kong dollar
Japan	NIKKEI 225	Japanese yen
Australia	ASX All Ordinaries	Australian dollar
South Korea	KOSPI200	Korean won
Thailand	Thailand Mai	Thai Baht
Indonesia	Jakarta Composite	Indonesian rupiah

Table 1 above displays the country, index used and currency. The stock market indices for each country are NZ50CAP, HNGKNGI, JAPDOWA, ASXAORD, KOR200I, BNGKMAI and JAKCOMP. Exchange rates against the US dollar for each currency were also collected through DataStream. The foreign exchange rate series are BBNZD1F, BBHKD1F, JI1MUSD, BBAUD1F, USKRW1F, TDTHB1F and USIDR1F. The time frame for the data collection is three years, daily.

2.1. Unit root test. This paper employs the unit root test by Dickey and Fuller (1981). The use of a unit roots test ensures that the data of a time series variable is non-stationary using an autoregressive model. We do so to ensure the data is stationary, ensuring all variables are $I(1)$, as variables that are $I(0)$ indicate an automatic long-run equilibrium correlation.

The Augmented Dickey-Fuller (ADF) unit root test, can be expressed in the form of

$$\Delta y_t = \psi y_{t-1} + \sum_{i=1}^p a_i \Delta y_{t-i} + u_t.$$

It also has a null of non-stationarity hypothesis where:

$$H_0: A \text{ unit root 'or' non-stationarity 'or' } \psi = 0.$$

H1: No unit root 'or' stationarity 'or' $\psi < 0$ since $\psi = \phi - 1$.

The unit roots test was carried out by firstly collecting the stock indices and exchange rates. The data for each country series was then tested for unit roots at the level series. To obtain the first difference of the level series the data employs an equation where $x = x - x(1)$.

2.2. The Engle-Granger two-step methodology.

Next, we use the Engle Granger technique in order to estimate the long-run equilibrium relationship in the application of the ADF unit root tests for the estimated residuals. We also do this to test the cointegration between the stock indices as the dependant variable with the exchange rates for each country, as well as to test the cointegration between the exchange rates as the dependant variable with the stock indices for each country. This is done by firstly estimating the cointegrating regression (long-term model) using OLS of the form: $y_t = \alpha_1 + \beta x_t + u_t$. Following this the residuals, u_t , are saved from the cointegrating regression and tested using the ADF to see if they are $I(0)$ under the assumption that:

H0: A unit root in the cointegrating regression residuals, $\hat{u}_t \sim I(1)$.

H1: No unit root in the cointegrating residuals, $\hat{u}_t \sim I(0)$.

When residuals are $I(0)$, this indicated stationarity and the null is rejected. From this we understand that there is cointegration in the regression, where the residuals of both variables are stationary.

The next step involves the estimation of the ECM (short-term model) using the residuals, u_t :

$$\Delta y_t = \beta_0 + \beta_1 \Delta x_t + \beta_2 (y_{t-1} - \gamma x_{t-1}) + v_t.$$

The proportion of the previous period's equilibrium error is measured through the ECM and corrected. β_2 signifies the proportion of the last period's deviation from the long-run equilibrium that Δy_t reacts to.

3. Results and findings

3.1. Unit root test. Table 2 below presents the results for the seven series of stock indices. At the level series, the ADF probabilities exceeded 0.05 for all seven countries, indicating unit roots. When tested at the first difference level, the ADF probabilities are all below 0.05. Therefore, it can be argued that there is only a single unit root for the stock prices for all seven countries. Table 3 shows the results for the seven series of exchange rates.

We can see that at the level series, the ADF probabilities are beyond 0.05, suggesting a unit root

for all seven countries. After being tested at the first difference level, the ADF probabilities are less than 0.05. Therefore, the results indicate that there is a single unit root for the exchange rates of all seven countries.

Table 2. Results of unit root test for stock market prices

ADF T-statistic: Unit root test for stock indices series stationarity			
Sample period: January 2006 to December 2008			
Code	Country	Level series (ADF Prob.)	First difference (ADF Prob.)
NZ50CAP	New Zealand	0.9954	0.000
HNGKNGI	Hong Kong	0.6142	0.000
JAPDOWA	Japan	0.9473	0.000
ASXAORD	Australia	0.9032	0.000
KOR200I	South Korea	0.7224	0.000
BNGKMAI	Thailand	0.7435	0.000
JAKCOMP	Indonesia	0.6289	0.000

Note: Level series refers to daily series for the stock index for each country (782 observations per country). First difference refers to the first difference of the level series (781 observations per country). Probabilities are derived using the ADF unit root test, where a unit root is present when prob. value is greater than 0.05.

Table 3. Results of unit root test for exchange rates

ADF T-statistic: Unit root test for exchange rate series stationarity			
Sample period: January 2006 to December 2008			
Code	Country	Level series (ADF prob.)	First difference (ADF prob.)
BBNZD1F	New Zealand	0.8071	0.000
BBHKD1F	Hong Kong	0.3917	0.000
J11MUSD	Japan	0.9261	0.000
BBAUD1F	Australia	0.6022	0.000
USKRW1F	South Korea	0.8983	0.000
TDTHB1F	Thailand	0.1804	0.000
USIDR1F	Indonesia	0.9367	0.000

Note: Level series refers to daily series for the exchange rates for each country (782 observations per country). First difference refers to the first difference of the level series (781 observations per country). Probabilities are derived using the ADF unit root test, where a unit root is present when probability value is greater than 0.05.

3.2. The Engle-Granger two-step methodology.

The results from the Engle-Granger tests are shown in Table 4 and Table 5. We can see that the ADF probability for the long run equilibriums are all less than 0.05, indicating a significant relationship between the stock prices and exchange rates in the long run for all countries. However, when tested for cointegration, the ADF probability falls beyond 0.05, with the exception of Japan. This means that the only indication of a cointegration relationship between stock price and exchange rates is present in the Japanese market, with a significance level of 5%.

The residuals for the other six countries are insignificant when tested for the ADF, implying that there are no cointegration relationships between

each country's stock prices and exchange rates. An error correction model is run for Japan, where it appears that the NIKKEI225 as the dependant variable has a positive relationship with the Japanese yen and a negative relationship with the residual series, both at the significant level. We also see that as the dependant variable, the Japanese yen has a positive relationship with the NIKKEI225 and a negative relationship with the residual series at the significant level.

Table 4. Results of test for long-run model for stock market prices and exchange rates

Long-run model between stock indices and exchange rates				
Sample period: January 2006 to December 2008				
Country	Stock indices to exchange rates		Exchange rates to stock indices	
	ADF prob.	Coefficient sign	ADF prob.	Coefficient sign
New Zealand	-	-	0	-
Hong Kong	-	+	0	+
Japan	-	+	0	+
Australia	-	-	0	-
South Korea	-	-	0	-
Thailand	-	-	0	-
Indonesia	-	-	0	-

Note: Above are results based on the long-run model for the relationship between stock prices and exchange rates for each country, where the first variable is the dependent variable and the second is the independent. For example stock indices and exchange rates mean stock indices is the dependent variable and exchange rates is the independent variable.

Table 5. Results of test for cointegration for stock market prices and exchange rates

Cointegration between stock indices and exchange rates				
Sample period: January 2006 to December 2008				
Country	Stock indices to exchange rates		Exchange rates to stock indices	
	ADF prob.	Cointegration	ADF prob.	Cointegration
New Zealand	0.9281	No	0.5699	No
Hong Kong	0.3356	No	0.1967	No
Japan	0.0155	Yes (5%)	0.018	Yes (5%)
Australia	0.7245	No	0.3968	No
South Korea	0.4985	No	0.8031	No
Thailand	0.2298	No	0.0524	No
Indonesia	0.5955	No	0.9252	No

Note: Above are results based on the residual series between stock prices and exchange rates for each country, where the first variable is the dependent variable and the second is the independent one.

The results of the study provide some findings that both accept and reject the popular view held by many investors who believe that, from a practical aspect, both stock prices and exchange rates can serve as tools of predictability for each other's future trends. Our findings support previous studies such as Lin (2000) in terms of the implications of a long-run relationship between stock market prices and exchange rates. At the same time the results also agree with Bahmani-Oskooe and Sohrabian's (1992)

and Nieh and Lee's (2001), that proclaim there exists a lack of cointegration between the two financial variables, stock market prices and exchange rates.

Through the augmented Dickey-Fuller unit root test, we see that both stock market prices and exchange rates for all the seven countries have a single unit root. Also, the data for each variable is only stationary at the first difference level. Based on the Engler-Granger test, it is apparent that all countries tested apart from Japan have no cointegration; however, the long-run equations are significant. For example, there is a long-run trend for New Zealand's stock market prices and exchange rates, however in the short run these two variables do not adjust for each other. The exception, Japan, appears to have a cointegration between stock market prices as the dependant variable and exchange rates as the independent variable, and vice versa. Both variables have a positive relationship with each other in both the long run and the short run, as tested through the error correction model.

Conclusions

This paper employs a similar methodology to Nieh and Lee (2001), but instead of employing data from the G-7 countries, we have used a sample set of seven Australasian countries. Unit root tests were conducted, followed by Engle and Granger's two-step methodology, resulting in the central finding of this paper whereby no significant long-run cointegration relationship between stock markets and exchange rates was found.

The unit roots test was used to ensure that the data of our time series variables were non-stationary, using an autoregressive model. The Engle and Granger's two step methodology was then employed to test the cointegration between the stock indices as the dependant variable with the exchange rates for each country, as well as to test the cointegration between the exchange rates as the dependant variable with the stock indices for each country.

As with Nieh and Lee's (2001) findings, our results may be the product of deeper causes. Hodrick (1990) suggested that our results could be influenced by not only the observed financial factors, but also factors such as each country's differences in economic stage, government policy, expectation patterns, differences in the degree of internationalization and liberalization and the degree of capital control. These influences can contribute to different predicting power of stock market prices and exchange rates. The insignificant long-run outlook (no cointegration) does, nevertheless, support and reject Nieh and Lee's (2001) findings; there is in the long run there is no cointegration present between stock market prices and exchange rates, but the long run coefficients are significant at the 1% level, implying some relationships in the very long run.

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