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The effects of currency appreciation on share market return: ARDL approach

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Abstract

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Keywords

ardl, approach, return, appreciation, market, effects, currency, share

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The effects of currency appreciation on share market return: ARDL approach

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ABSTRACT

This study employs the ARDL cointegrating approach to examine the impact of financial liberalization on the relationships between three Chinese main bilateral exchange rates and its share market performance. We discovered that a long-term equilibrium relationship measured by cointegration has emerged between the exchange rate of the RMB against the Japanese Yen and, to a lesser extent, the exchange rate against both the US dollar and Hong Kong dollar and the Shanghai Composite Index since 2005 when the Chinese exchange rate regime changed from a peg system to a more flexible managed floating system. We found that the exchange rate actually influenced stock price with a positive correlation instead of a negative one as suggested by the goods market theory for an export-oriented economy. We documented that after local currency appreciation, "hot money" flowing from foreign funds into the local markets followed by local investors' speculations on markets pushed the market into a high level based on the expectation of the local currency's further appreciation.

JEL Classification: F31, F41, G20, N27

Key word: share market index, exchange rate, ARDL cointegration, causality, China

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1. INTRODUCTION

Over recent years there has been an increasingly close relationship between national stock markets and their respective exchange rates, as a result of the rising flows of capital between international financial markets. The analysis of the interactions between stock prices and exchange rates is particularly interesting and important from the perspective of emerging marks such as the Chinese market, one of the largest emerging markets, for a couple of reasons.

First, Chinese markets have been similar in recent years to the most other emerging markets at the forefront of financial market liberalization. China abandoned the fixed peg exchange rate regime in July 21 2005, when the Chinese Yuan had been pegged at 8.3 to a US dollar for the past 10 years and foreign governments had been pressuring China to move towards a more flexible managed floating exchange rate. Officially it shifted to what may be best referred to as a more mechanical version of a currency basket regime (i.e., keeping the trade weighted exchange rate within a certain band as a goal in and of itself)[2]. Secondly, Chinese stock markets have developed and opened to external investors recently by introducing Qualified Foreign Institutional Investors (QFII) in 2003 and provided channels to local investors to be able to invest in external markets by implementing Qualified Domestic Institutional Investors (QDII) in 2005. However, both the liberalisation of the foreign exchange market and the opening up of local stock markets became more prone to contagion effects once their integration in the global financial markets intensified. Between July

[2] Contrary to the public pronouncement of the Chinese authorities that the currency is a based on a currency basket, recent empirical studies suggest the *de facto* regime appears to be a soft peg to the US dollar with a the IMF classifies China under “other conventional fixed peg arrangements” See Shah, Zeileis and Patnaik (2006) and Ogawa and Sakane (2006) for empirical validation.

2005 and April 2008 while writing this paper, the Chinese Yuan appreciated from 8.3 to almost below the landmark 7.0, by 20%, while the Shanghai composite index rapidly rose from 1007 to 6100 in October 2007 its highest and fell to around 4500 in April 2008. Nearly 50% fell from its highest was largely due to the international stock market correction trigged by the American subprime loan crises. Overall, the increase in the Shanghai stock index seems to have been caused by the appreciation of the Chinese Yuan since the Yuan had a flexible managed floating rate in 2005.

There are two main theories (approaches) that explain the relationship between share price and exchange rate. The goods market approach (also called either "flow-oriented" models or traditional approach) assumes that the exchange rate is determined largely by a country's current account or trade balance performance. This approach posits that changes in exchange rates affect international competitiveness and trade balance, thereby influencing real economic variables such as real income and output (Dornbusch – Fisher, 1980). Stock prices, usually defined as the present value of the future cash flow of companies, should adjust to economic perspectives[3]. Therefore this approach indicated that currency appreciation is expected to stimulate the share market of an import-dominant country and depress that of an export-dominant economy and visa versa for the impact of currency depreciation (Obben et al 2007). In other words, a positive correlation between exchange rage and stock price is expected in an import-dominant economy while a negative correlation is expected for an export-dominant economy. Since the definition of an export or import-dominant country has been ambiguous for quite some time, the net effect of the aggregation (stock index) cannot be determined and therefore the sign is arbitrary.

[3] Even firms that are not internationally integrated (low ratio of exports and imports to total sales and a low proportion of foreign currency-denominated assets and liabilities) may be indirectly affected.

Consequently, the empirical results based on these models are mixed and contrasting of each other over the past three decades

Alternatively, the portfolio balance theory (also called “stock-oriented” models) argues that changes in stock prices may influence movements in exchange rates via portfolio adjustments (inflows/outflows of foreign capital). If there were a persistent upward trend in stock prices, inflow of foreign capital would rise. However, a decrease in stock prices would induce a reduction in domestic investor wealth, leading to a fall in demand for money and lower interest rates, causing capital outflows that would result in currency depreciation. Therefore, under the portfolio balance approach, stock prices would influence exchange rates with a negative correlation. Overall, there is no theoretical consensus on either the existence of a relationship between stock price and exchange rate or its direction.

The relationship between stock price and exchange rate has been empirically analysed over the past three decades. Using the Granger concept of causality and cointegration, Bahmani-Oskooee and Sohrabian (1992) found that in the short run there is causal relationship between US stock prices and the effective exchange rate of the US dollar. They also found there is no co-movement between stock prices and exchange rates. The results from following research are somewhat mixed as to the significance and the direction of influences between stock prices and exchange rates. These research include Ajayi and Mougoue (1996), Amihud and Bartov and Bohnar (1994), Nieh and Lee (2001), Abdalla and Murinde (1997), Wu (2000)， Mishra (2004) and Wickremasinghe (2006).

The Asian financial crisis and associated dramatic fall of the local currency has provided ample opportunities to examine the effect of devaluation on stock prices. Granger *et al*. (2000) studied the causal relationships between stock prices and exchange rates by using the data of Asian markets between January 1986 and June 1998. They reported that the data from South Korea was consistent with the traditional approach that exchange rates lead stock prices. However, the data from the Philippines was consistent with the portfolio approach that stock prices lead exchange rates with a negative correlation. Data from Hong Kong, Malaysia, Singapore, Thailand and Taiwan indicated strong feedback relations. The data for Indonesia and Japan did not reveal any causal relationship. Yong and Isa (2000) and Fang (2002) also examined the impact of currency depreciation on stock returns and/or increased market volatility over the period of the Asian crisis. As a matter of fact, a majority of the results found that exchange rates Granger- cause stock price for a majority of export-dominant East Asian countries with a positive correlation, which is opposite to what was expected from the goods market approach.

Recently literature has started to focus on the impact of financial liberalization on the relation between exchange rate and stock price. By examining the impact of stock market liberalisation on foreign exchange and stock markets, Phylaktis and Ravazzollo (2005) found that stock and foreign exchange markets are positively related and that the US stock market acted as a conduit for these links. Tabak (2006) in Brazil, Murinde and Poshakwale (2004) in Hungary, Poland and Czech Republic, and Horobet and Ilie (2007) in Romania also examined the impact of financial liberalisation and found mixed results in their respective study.

In summary, both theoretical economists and empirical researchers are far from reaching any consensus regarding the interaction between stock market and foreign exchange markets and therefore it is advisable to carry out further tests and analysis of this issue.

Apart from the theoretical gap, the mixed and contrasting empirical results might also be attributed to the inappropriate statistical methods applied in previous studies. Most articles only applied the DF test for the unit root, which is not robust for structure break(s). The only exception is Granger et al 2000, which used the Zivot and Andrews (1992) (Z-A) test for the unit root. As argued by Granger et al (2000) the null hypothesis of a unit root in exchange rates cannot be rejected using DF test and is more easily rejected by using more robust tests such as the Z-A test for some markets The prevalence of the lack of a unit root may be attributed to the fact that these currencies were pegged to the US dollar before they became floating. This issue became particularly important when considering countries which were transferred from the peg system to a more floating system.

The proposed methodology for cointegration in this article is the ARDL approach (Pesaran and Shin, 1995, 1998; Pesaran et al., 1996; Pesaran et al. 2001). More recent studies have indicated that the ARDL approach to cointegration is preferable to other conventional cointegration approaches such as that of Engle and Granger (1987), Johansen (1988), Johansen and Juselius (1990) and Gregory and Hansen (1996). Gregory and Hansen (1996) was applied in Granger et al (2000) article. One of the reasons for preferring the ARDL is that it is applicable irrespective of whether the underlying regressors are purely $I(0)$, purely $I(0)$ or mutually cointegrated[4]. The

[4] An advantage of the ARDL bounds testing approach is that the critical values produced by Pesaran et al. (2001) allow for the inclusion of a mix of I(0) and I(1) variables in the cointegrating relationship.

statistic underlying this procedure is the familiar Wald or F-statistic in a generalized Dickey-Fuller type regression, which is used to test the significance of lagged levels of the variables under consideration in a conditional unrestricted equilibrium error correction model (ECM) (Pesaran, et al. 2001, pp. 289-290). Another reason for using the ARDL approach is that it is more robust and performs better for small sample sizes (such as in this study) than other cointegration techniques.

There are a few reasons why such a study on China is important. The Chinese case provides a unique case study. First, the recent opening of the Chinese stock markets to foreign investors and liberalising of its currency provides an opportunity to examine the impact of financial liberalization on the relation between foreign exchange rate and stock price. Furthermore, the three years post new foreign exchange regime provides just enough observations to examine the effect of the local currency on stock price. Secondly, the Chinese Exchange's change from a peg system to a managed float system (instead of flexible system) provides a simple case to examine the effect of exchange rate on stock price change. Since stock price will not affect exchange rate as much as expected in a flexible exchange rate regime, our examination will not be complicated with the effect of stock price on exchange rate. Thirdly, there is no single research on the appreciation on stock prices, although observations have been made regarding the effect of currency of the Japanese Yen on Japanese stock prices. Therefore, this study on Chinese stock price provides the first study examining the impact of currency appreciation on stock prices. Lastly, since the opening of Chinese markets, foreign investment in local Chinees markets has rapidly increased over the

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Although the Johansen ML approach can also be used with a mixture of I(0) and I(1) variables, Rahbek and Mosconi (1999) suggest that including I(0) series in a VECM can produce nuisance parameters in the asymptotic distribution of the trace for the cointegration rank. See Wickens (1996) for further concerns over the Johansen ML procedure and Tawadros (2001) for a discussion of the difficulties in interpreting the results from this technique for the monetary model.

last few years and our results should be of interest to foreign portfolio investors concerned with their currency exposure in China.

This paper is to examine whether there is any evidence of causality between the exchange rate and stock price in the long and short run and to capture either one or both of the portfolio balance and goods market approaches that can help to characterise the linkage between the fluctuations in equity and foreign exchange markets. The goods market theory/model would expect the appreciation of the Chinese Yuan in recent years to be hurting Chinese exporters and therefore the shares of such companies would be less desirable and affect the share market index. This presumes causality to run from exchange rates to the share market. The portfolio balance theory, on the other hand, asserts that causality runs from the share market to the exchange rate. Both the theory and empirical evidence are ambiguous as to whether it is the exchange rate that affects the share market or the other way round. In the application of the ARDL cointegration we examined the impact of financial liberalization on the relations between three Chinese main bilateral exchange rates and its share market performance. We discovered a long-term equilibrium relationship measured by cointegration merged between the exchange rate of the RMB against the Japanese Yen and, to a lesser extent, the exchange rate against both the US dollar and Hong Kong dollar and the Shanghai Composite Index since the financial liberalization in 2005. We found that the exchange rate actually influences stock price with a positive correlation instead of a negative one as suggested by the goods market theory for an export-oriented economy.

This paper is organized as follows. In the next section, we present the data and methodology employed. Section 3 shows the empirical evidence for the

interdependencies between stock prices and exchange rates in China. Section 4 concludes the paper with further discussion based on the findings.

2. Methodology and Dataset

The ARDL approach involves estimating the conditional error correction version of the ARDL model for variables under estimation. The augmented ARDL $(p, q_1, q_2, ..., q_k)$ is given by the following equation (Pesaran and Pesaran, 1997; Pesaran and Shin, 2001):

$$\alpha(L,p)y_t = \alpha_0 + \sum_{i=1}^{k} \beta_i(L,q_i)x_{it} + \lambda' w_t + \varepsilon_i \quad \forall_t = 1,2,...,\text{n} \tag{1}$$

where

$$\alpha(L,p) = 1 - \alpha_1 L - \alpha_2 L^2 - ... - \alpha_p L^p$$

$$\beta_i(L,q_i) = \beta_{i0} + \beta_{i1L} + \beta_{i2}L^2 + ... + \beta_{iq_i} L^{q_i} \quad \forall_t = 1,2,...,k$$

y_t is the dependent variable, α_0 is the constant term, L is the lag operator such that $Ly_t = y_t - 1, w_t$ is $\text{s} \times 1$ vector of deterministic variables such as intercept term, time trends, or exogenous variables with fixed lags. The long-run elasticities are estimated by:

$$\hat{\phi}_i = \frac{\hat{\beta}_i(1,\hat{q}_i)}{\phi(1,\hat{p})} = \frac{\hat{\beta}_{i0} + \hat{\beta}_{i1} + ... + \hat{\beta}_{i\hat{q}}}{1 - \hat{\alpha}_1 - \hat{\alpha}_2 ... - \hat{\alpha}\hat{\phi}_{\hat{p}}} \quad \forall i = 1,2,...,k \tag{2}$$

where $\hat{p}$ and $\hat{q}_i, i = 1,2,...,k$ are the selected (estimated) values of $\hat{p}$ and $\hat{p}_i, i = 1,2,...,k$.

The long-run coefficients associated with the deterministic/exogenous variable with fixed lags are estrimated by

$$\pi = \frac{\hat{\lambda}(\hat{p}, \hat{q}_1, \hat{q}_2, ..., \hat{q}_k)}{1 - \hat{\alpha}_1 - \hat{\alpha}_2 - ... - \hat{\alpha}_{\hat{p}}} \tag{3}$$

where $\hat{\lambda}(\hat{p}, \hat{q}_1, \hat{q}_2, ..., \hat{q}_k)$ denotes the OLS estimates of λ in equation (1) for the selected ARDL model.

The ARDL approach involves two steps for estimating the long run relationship (Pesaran et al., 2001). The first step is to investigate the existence of a long run relationship among all variables in the equation under estimation. The ARDL method estimates ($(p+1)^k$ number of regressions in order to obtain the optimal lag length for each variable, where p is the maximum number of lags to be used and k is the number of variables in the equation. The second step is to estimate the long-run relationship and short-run bi-directional causality between running actors. We run the second step only if we find a long-run relationship in the first step (Narayan et al., 2005). This study uses a more general formula of the ECM with an unrestricted intercept and unrestricted trends (Pesaran et al., 2001):

$$\Delta y_t = c_0 + c_1 t + \pi_{yy} y_{t-1} + \pi_{yx.x} + \sum_{i=1}^{p-1} \psi_i^{'} \Delta z_{t-1} + w' \Delta X_t + \mu_t \tag{4}$$

Where $c_0 \neq 0$ and $c_1 \neq 0$. The Wald test (F-statistics) for the null hypothesis $H_0^{\pi_{yy}} : \pi_{yy} = 0, H_0^{\pi_{yx.x}} : \pi_{yx.x} = 0'$, and alternative hypothesis $H_1^{\pi_{yy}} : \pi_{yy} \neq 0, H_1^{\pi_{yx.x}} : \pi_{yx.x} \neq 0'$. Hence the joint null hypothesis of the interest in the above equation is given by: $H_0 = H_0^{\pi_{yy}} \cap H_0^{\pi_{yx.x}}$, and alternative hypothesis is correspondingly stated as: $H_0 = H_1^{\pi_{yy}} \cap H_1^{\pi_{yx.x}}$.

The asymptotic distributions of the F-statistics are non-standard under the null hypothesis of no cointegration relationships between the examined variables, irrespective of whether

the variables are purely $I(0)$ or $I(1)$, or mutually co-integrated. Two sets of asymptotic critical values are provided by Pesaran and Pesaran (1997). The first set assumes that all variables are $I(0)$ while the second set assumes that all variables are $I(1)$. If the computed F-statistic is greater than the upper bound critical value, then we reject the null hypothesis of no cointegration and conclude that there exists a steady state of equilibrium between the variables. If the computed F-statistic is less than the lower bound critical value, then we cannot reject the null of no cointegration. If the computed F-statistic falls within the lower and upper bound critical values, then the result is inconclusive. The model can be selected using the lag length criteria of Schwartz-Criteria (SBC) or Hannan-Quinn (HQ) information criterion.

Following the discussion of theoretical models and the ARDL technique, we employed the Pesaran *et al (2001)* procedure to investigate the existence of a long-run relationship in the form of the unrestricted error correction model for each variable as follows regarding our issues:

For RMB with USD:

$$\Delta \ln SHA_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{p} \alpha_2 \Delta \ln SHA_{t-1} + \sum_{i=o}^{p} \alpha_3 \Delta EUSD_{t-1} + \alpha_4 \ln SHA_{t-1} + \alpha_5 EUSD_{t-1}$$
$$+\alpha_6 D(Tb)_t + \alpha_7 DU_t + \eta_i \quad (5)$$

$$\Delta \ln USD_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{p} \alpha_2 \Delta \ln SHA_{t-1} + \sum_{i=o}^{p} \alpha_3 \Delta EUSD_{t-1} + \alpha_4 \ln SHA_{t-1} + \alpha_5 EUSD_{t-1}$$
$$+\alpha_6 D(Tb)_t + \alpha_7 DU_t + \eta_i \quad (6)$$

For RMB with HKD:

$$\Delta \ln SHA_t = \beta_0 + \beta_1 t + \sum_{i=1}^{p} \beta_2 \Delta \ln SHA_{t-1} + \sum_{i=o}^{p} \beta_3 \Delta EHKD_{t-1} + \beta_4 \ln SHA_{t-1} + \beta_5 EHKD_{t-1}$$
$$+\beta_6 D(Tb)_t + \alpha_7 DU_t + \mu_i \quad (7)$$

$$\Delta \ln HKD_t = \beta_0 + \beta_1 t + \sum_{i=1}^{p} \beta_2 \Delta \ln SHA_{t-1} + \sum_{i=o}^{p} \beta_3 \Delta EHKD_{t-1} + \beta_4 \ln SHA_{t-1} + \beta_5 EHKD_{t-1}$$
$$+\beta_6 D(Tb)_t + \alpha_7 DU_t + \mu_i \quad (8)$$

For RMB with JPY:

$$\Delta \ln SHA_t = \gamma_0 + \gamma_1 t + \sum_{i=1}^{p} \gamma_2 \Delta \ln SHA_{t-1} + \sum_{i=o}^{p} \gamma_3 \Delta EJPY_{t-1} + \gamma_4 \ln SHA_{t-1} + \gamma_5 EJPY_{t-1}$$
$$+\gamma_6 D(Tb)_t + \alpha_7 DU_t + \varpi_i \quad (9)$$

$$\Delta \ln JPY_t = \gamma_0 + \gamma_1 t + \sum_{i=1}^{p} \gamma_2 \Delta \ln SHA_{t-1} + \sum_{i=o}^{p} \gamma_3 \Delta EJPY_{t-1} + \gamma_4 \ln SHA_{t-1} + \gamma_5 EJPY_{t-1}$$
$$+\gamma_6 D(Tb)_t + \alpha_7 DU_t + \varpi_i \quad (10)$$

Where SHA is the Shanghai stock index, EUSD, EHKD and EJYP are the real exchange rates of RMB against USD, HKD and YPY respectively, t is the time trend variable, while η, μ and ω are error terms in the models. The first part of these equations with $\alpha_2, \alpha_3, \beta_2, \beta_3$, and γ_2, γ_3 represent the short-run dynamics of the models whereas the second part with $\alpha_4, \alpha_5, \beta_4, \beta_5$, and γ_4, γ_5 represent the long-run phenomenon. The null hypothesis in the equation (5/6) is $\alpha_4 = \alpha_5 = 0$, means the non-existence of a long-run relationship and vice versa. The null hypothesis in the Equation (7/8) is $\beta_4 = \beta_5 = 0$, which means the non-existence of the long-run

relationship and vice versa, while the null hypothesis in Equation (9/10) is $\gamma_4 = \gamma_5 = 0$, which means the non-existence of a long-run relationship and vice versa. The third stage includes conducting standard Granger causality tests augmented with a lagged error-correction term. The Granger representation theorem suggests that there will be Granger causality in at least one direction if there exists a co-integration relationship among the variables provided the variables are integrated in the order of one. An augmented form of the Granger causality test is involved to the error-correction term and it is formulated in a bi-variate *p*th order vector error-correction model (VECM) which is as follows:

$$\begin{bmatrix} \Delta \ln SHA_t \\ \Delta EJPY_t \end{bmatrix} = \begin{bmatrix} k_1 \\ k_2 \end{bmatrix} + \sum_{I=1}^{P} \begin{bmatrix} d_{11}(L) \; d_{12}(L) \\ d_{21}(L) \; d_{22}(L) \end{bmatrix} \begin{bmatrix} \Delta \ln SHA_{t-i} \\ \Delta EJPY_{t-i} \end{bmatrix} + \begin{bmatrix} \gamma_1 ECT_{t-1} \\ \lambda_1 ECT_{t-1} \end{bmatrix} + \begin{bmatrix} C_1 \\ C_2 \end{bmatrix} + \begin{bmatrix} \eta_1 \\ \eta_2 \end{bmatrix} \tag{11}$$

Where Δ is the difference operator, ECT representing the error-correction term derived from the long-run co-integrating relationship via the ARDL model, C(i = 1, 2) is constant and η (i = 1, 2) are serially uncorrelated random disturbance terms with a mean of zero. Through the ECT, the VECM provide new directions for Granger causality to appear. Long-run causality can be revealed through the significance of the lagged ECTs by a t test, while the F-statistic or Wald test investigate short-run causality through the significance of a joint test with an application of the sum of lags of explanatory variables in the model.

To ascertain the goodness of fit of the ARDL model, the diagnostic test and the stability test are conducted. The diagnostic test examines the serial correlation, functional form, normality and heteroscedisticity associated with the model. The

stability test is conducted by employing the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of the squares of recursive residuals (SUSUMsq).

The data consists of monthly stock market index prices expressed in local currency and local bilateral spot exchange rates, expressed as domestic currency per U.S dollars, and consumer price index over the December 1995 – April 2008 period. All the series are expressed in logarithmic form. The real exchange rate is defined as:

Real exchange rate = $\ln S = \ln E + \ln CPI^{\text{foreign}} - \ln CPI^{local}$

where CPI^{local} is the consumer price index for China, E is the norminal exchange rate and CPI^{foreign} is the consumer price index for the respective country.

The exchange rates utilised in the study are for those major currencies used in constructing China's trade weighted index (TWI) series. These conclude the bilateral nominal exchange rate of the RMB against the US dollar (EUSD), the Hong Kong dollar (EHKD), and the Japanese yen (EJPY). The exchange rate convention applied is the price of the domestic currency (i.e., the RMB) in units of the foreign currency[5]; hence an increase implies appreciation of the RMB, and a decrease implies a depreciation of the RMB. All data was collected on a monthly basis at the end of period and was retrieved from the People's Bank of China and DataStream. This study uses the most popular index, the Shanghai Composite Index for representing share market performance in China.

3. Empirical Results

[5] Chinese official foreign exchange rate however adopts the indirect quotation system, in which the price of the foreign currency (i.e., the US dollar) is measured in units of the local currency. For example, the exchange rate of RMB against the US dollar is expressed as 7 yuan/US dollar. In the text, we still use the Chinese official quotation system when we discuss Chinese currency appreciation.

Both the Augmented Dickey-Fuller (ADF) tests and Zivot-Andrew tests were carried out on time series in levels and differenced forms. ADF statistics exhibit nonstationary log Shanghai stock index at a significance level of 5% (Table 3). It is clear that all return (log difference) series are stationary for all periods whether a trend is included in the testing equation or not. Perron (1989) demonstrated by using traditional tests that in the existence of a structure break in time series, many perceived nonstationary series were in fact stationary. Further elaborated work by Zivot and Andrew (1992) overthrew the presumed exogenous break point and develops a unit-root test with an endogenous structure break, which has been regarded as a more suitable test for the order of integration of series (Nieh and Yau 2004)[6]. The results of the Zivot-Andrew tests indicated that the lnSHA series carry unit-roots in the level and reject the null of "non-stationary" in the first difference. The results for all exchange rates before 2005:07 are I(0); while they became the *I*(1) type afterward.

TABLE 1. Unit root tests, monthly

Market	Aug. Dickey-Fuller	Aug. Dickey-Fuller	Zivot-Andrews	Zivot-Andrews	Structure break
	Levels	First differences	Levels	First differences	
Prior Liberalization	1994M01-2005M06				

[6] It is well known that the conventional ADF and PP unit root tests are biased towards the non-rejection of the unit root null hypothesis in the presence of structure breaks. These tests lack power in the presence of structure breaks in series and they may fail to show whether a series is first difference stationary (Wilson, et. al. 2003, p. 445). Structure changes may occur in a time series for different reasons such as during economic and political crisis, environmental crisis, institutional changes or policy changes.

LSHA	-1.66	-4.74**	-3.62	-5.75**	1996M6
LEUSD	-9.79**	-12.96**	-4.85**	-6.34**	1998M8
LEHKD	-2.63	-5.53**	-5.75**	-7.59**	1999M2
LEJPY	-2.35	-3.77**	-5.51**	-8.29**	1998M8
Post Liberalization	2005M07-2008M03				
LSHA	-1.34	-4.92**	-1.49	-5.55**	2006M12
LEUSD	2.35	-5.42**	-1.31	-4.97**	2007M10
LEHKD	-2.60	-4.53**	-2.75	-5.59**	2006M04
LEJPY	-2.35	-4.87**	-2.51	-5.29**	2007M08

Notes: "GLS-Dickey-Fuller" is the generalized least squares (GLS) demeaned Dickey-Fuller test Elliott, Rothenberg and Stock (1996). The 5% critical value for all these test statistics is -2.86. Number of lags was selected optimally using the Schwarz criterion. The Zivot and Andrews (1992) test assumes that the series undergoes a deterministic shift in both the mean and trend. The timing of the break is endogenous. For our sample size the 5% critical value of the test is -4.8.

The ARDL model requires a prior knowledge or estimation of the orders of the extended ARDL. The order of the distributed lag on the dependent variable and the regressors is selected using the Schwartz Bayesian Criterion (SBC). Depending on Monte Carlo evidence, Pesaran and Smith (1998) found that the SBC is preferable to the AIC. The maximum lag is set to 12 for our monthly data. The results of the F-statistics for testing the joint level significance of the lagged level are reported in Table 2.

Table 2 F-Statistics for Testing the existence of a long-run relationship

	Equation	The calculated F-statistics
Prior liberalization period		
USD-SHA	Eq. 5: F(SHA/USD)	1.4
	Eq. 6: F(USD/SHA)	1.91
HKS-SHA	Eq. 7: F(SHA/HKD)	1.34
	Eq. 8: F(HKD/SHA)	2.05

JPY-SHA	Eq. 9: F(SHA/JAP)	2.52
	Eq. 10: F(JAP/SHA)	2.34
Post liberalization period		
USD-SHA	Eq. 5: F(SHA/USD)	4.86*
	Eq. 6: F(USD/SHA)	1.22
HKS-SHA	Eq. 7: F(SHA/HKD)	4.86*
	Eq. 8: F(HKD/SHA)	1.3
JPY-SHA	Eq. 9: F(SHA/JAP)	5.09*
	Eq. 10: F(JAP/SHA)	0.44

Note:

The relevant critical value bounds are obtained from Pesaran and Shin (2001).

We use Table CI(v) Case V (with unrestricted intercept and unrestricted trend), where the critical values in the case of 1 regressor are 4.04 – 4.79 at a 10% significant level and 4.93 – 5.76 at a 5% significant level.

* denotes that the F-statistic falls above the 90% upper bound.

** denote that the F-statistic falls above the 95% upper bound.

For the post financial liberalization period, in the case of Equations 5, 7 and 9, where the Shanghai stock index is a dependent variable, the result indicates that the calculated F-statistics are greater than the up critical value at a 10% significance level.

Table 3 reports the long-run coefficient estimates. Equations (5-10) are based on the ARDL model selected by the SBC. Table 3 shows that the long-run coefficients for the regressor, namely lnUSD, lnHKD and lnJYP, are positive and highly significant at 5% levels in Equations 5, 7 and 9 respectively, while the regressor lnSHA is very small and insignificant in Equation 6. The above test results suggest that there existed a long-run relationship between LSHA and LUSD, between LSHA and LHKD and between LSHA and LJAP after the financial liberalization in China, while there was no cointegration relationship between exchange rates and stock market price performance before liberalization. The variable LUSD, LHKD and LJAP can be treated as the 'long-run forcing' variable for the explanation of LSHA in the period

post to financial liberalization. An increase in the exchange rate of the RMB against the Hong Kong dollar by 1% will have a significant long-run impact on the Shanghai stock price index by 18%, whereas an increase in the exchange rate of the RMB against the Japanese yen (lnYPY) by 1% will have a significant long-run impact on the stock price index (lnSHA) by 13% after the Chinese currency changed from a peg system to a managed floating rate system in 2005. There is clearly a positive effect of foreign exchange rate on stock price index.

Table 3 Long-run coefficient estimated based on ARDL model selected based on SBC

	Dependent variable: lnSHA Post 2005	Dependent variable: lnSHA Post 2005	Dependent variable: lnSHA; Post 2005	Dependent variable: lnUSD; Prior 2005
	ARDL (3,2)	ARDL (1,0)	ARDL(1,4)	ARDL(8,0)
Intecept	4.66** (23.11)	7.44** (33.09)	-27.46** (-3.67)	-2.11** (-714)
lnUSD	15.22* (4.34)			
lnHKD		18.16** (4.61)		
lnJAP			13.19** (4.74)	
lnSHA				-0.00029 (-0.72)
T	0.067** (5.21)	0.032** (4.41)	0.065** (5.23)	0.0035* (2.23)
DU	-0.0087** (-3.95)	-0.0043** (-3.45)	-0.025** (2.89)	-0.076** (2.95)

Notes: * and ** denote a significance at a 10% level and 5% level respectively.

The estimated error correction model (ECM) of the selected ARDL (1, 4) for Equation 9 is presented in Table 4 and the results show that the coefficient of the ECM is negative, as expected, and highly significant at a 5% level. The ECM represents the speed of adjustment of the dlnSHA to its long-run equilibrium following a shock. Moreover, the significance of the ECM confirms the existence of a stable long-run relationship and points to a long-run cointegration relationship between the significant regressor and the dependent variable. The ECM suggests that

following a shock and an adjustment of 12% back to long-run equilibrium is completed after one month. In addition to their long-run cointegration relationship, the result also suggest that the exchange rate of the RMB against Japanese Yen over the past three months has Granger caused the Shanghai stock index, as we cannot accept the null hypothesis of non causality running from the lnYPY to lnSHA. On the other hand, the ECM model of the selected ARDL(1,0) for Equation 7 indicates that the coefficient of the ECM is positive and insignificant. A similar result was achieved for Equation 5 where lnUSD is explanatory variable. Therefore, the existence of a stable long-run cointegration relationship both between the lnHKD and lnSHA and between lnUSD and lnSHA is not confirmed. We also include the results of the short run diagnostic tests for the ECM model, which indicates that our results are robust. The stability test is further conducted by employing the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of the squares of recursive residuals (SUSUMsq), which are presented in Figure 1 and 2. These results further confirm the robustness of our results achieved in the Diagnostic Tests in Table 4.

Table 4 Error correction model (ECM) results for the selected ARDL selected based on SBC

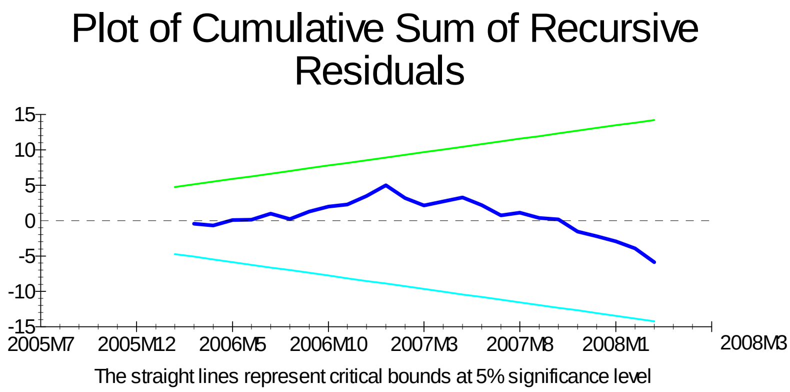
Dependent variable: dlnSHA

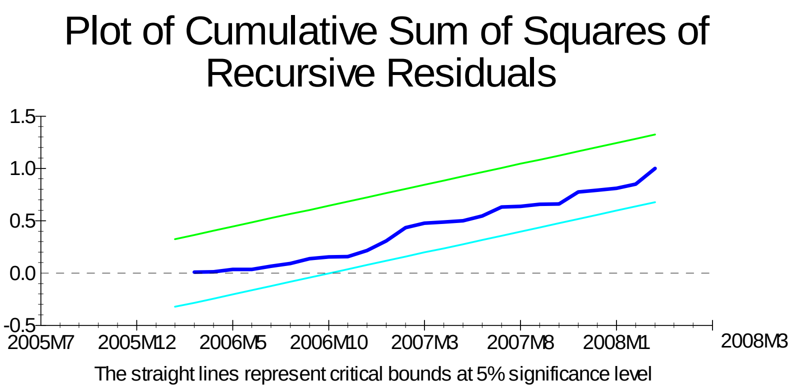
Regressors	ARDL(1,4)	ARDL(1,0)
dlnJAP	0.31	
	(0.54)	
dlnJAP(-1)	-1.12	
	(-1.64)	
dlnJAP(-2)	-0.67	
	(-1.02)	
dlnJAP(-3)	1.25*	
	(1.91)	
dlnHKD		-2.19**
		(-2.09)
T	0.0032**	0.0013**
	(4.42)	(3.45)
dDU	-0.0034	-0.0046
	(-0.265)	(-0.311)

Ecm(-1)	-0.12** (-2.85)	0.12 (0.102)
Short Run Diagnostic Tests for the Equation 9: Serial Correlation LM Test = 0.899(0.584) ARCH Test = 0.608 (0.803)		

Notes: * and ** denote a significance at a 10% level and 5% level respectively.

Figure1





4. Conclusions

We found that after the Chinese financial market liberalization including the opening of the stock markets to foreign investors and the change of the exchange rate system from one where its currency was pegged to the US dollar to a more flexible managed

floating system, the Yuan became cointegrated with other currencies such as the Japanese Yen. The weak-existence of the long run cointegration between HKD and USD and Chinese stock price respectively may be attributed to the fact that the HK dollar was still pegged to the USD. We found that a 1% change in the Japanese Yen will cause a 13% increase in the Shanghai stock market index in long run. We also found that in the short run the Japanese Yen in the past three month Granger caused the changes in the Shanghai stock market.

Our results support neither the goods market theory nor the portfolio balance theory. It is understandable that the portfolio theory was not supported due to Chinese still having a managed floating exchange rate. Therefore, it is not expected that stock price affects exchange rate as much as expected in a floating exchange rate regime. On the other hand, the goods market theory was also not supported in our study. We found that the exchange rate (the exchange rate of the RMB against the Japanese Yen) actually influences the stock price with a positive correlation instead of a negative correlation as suggested by the goods market theory for an export-oriented economy.

We argue that at least in a short period of time just after local currency depreciation or appreciation, a positive correlation may dominate the negative correlation. Evidence was found in most South East countries when stock prices fell dramatically after the local currency depreciation in the crisis (Granger et al 2000). When local currency depreciated, foreign funds withdrew from the local share market and pushed the market down based on the expectation of the local currency's further depreciation. In the longer term, the expectation of a local currency fall will diminish and while a low foreign exchange pushes the interest rate low, reducing the cost of capital and

promoting firms' export activities, this pushes up the local market price, and finally the share price starts to rise, therefore reversing the positive correlation into a negative correlation between the exchange rate and stock price. The reversal from a positive correlation to a negative correlation in the longer term was found in Wu (2000) when he examined the impact of currency depreciation on stock prices in Asia.

A well documented case but not yet published as an empirical research on the impact of currency appreciation is the case of Japanese market when the appreciated Japanese yen resulted in a rise in the stock price over the first few years after 1985, although in the long term, the stock price started to fall after 1989. Although the cause and effect of the stock market "bubbles" after the currency appreciation between Japan and China might be different, the effect of currency appreciation on the stock market is very similar and an important issue which needs to be further discussed[7].

The exchange rate of the Chinese Yuan, built on a large foreign exchange surplus from export-led economic growth, had remained fairly stable (at approximately 8.33 to 8.22 Yuan per US dollar under peg system) before 2005. Since then, its currency began to appreciate in value owing to pressure from the US and other Western European countries. The appreciation took place gradually so as to minimize the impact on firms. Such a policy was indeed considered suitable to alleviate the adverse

[7] In September 22 1985, in order to reduce the huge Japanese trade surplus with the US, the Japanese Yen experienced a sudden appreciation in the wake of the Plaza Accord of September 1985. Japan was also under strong pressure from the United States to lower its interest rates. The value of the yen continued to rise even after Black Monday, going from around Y140 to the US dollar in October 1987 to about Y120 to the US dollar the following autumn. The official discount rate, which had been 5 per cent since October 1983, was lowered in steps starting in January 1986, and in February 1987 it became 2.5 per cent, the lowest level ever. This loosening of monetary policy was seen as necessary to cope with the sudden appreciation of the yen in the wake of the Plaza Accord of September 1985 (Noguchi, 1994). However, it also created excess liquidity which pushed the asset prices including stock and real estate price to a very high level. The Nikkei 225 increased from 12,700 to 26,642 on the Black Monday October 18 1987, an increased of 107%. The Nikkei fell from its highest point at 26,642 to 22,767 and returned to its highest point shortly in April 1988, retaining this level until 1989.

effects on domestic manufacturers, but served as an open invitation to "hot money" which flowed into China's financial market. It was estimated that the flow of "hot money" into the market increased from USD7.1 billion each year for the period between 2002 and 2004, to USD113.3 billion each year for the period 2005-07, and this figure reached 119.5 in the first five months in 2008 (Table 5). As a result, the inflow of hot money as a percentage of the increased amount of total foreign currency reserve in China rose dramatically from about 3% in 2002 to 44.5%. The overflow of this hot money inevitably led to an overheated stock market, real estate market, and overvalued prices. In addition, the overflow of the hot money noticeably increased the demand for the Chinese Yuan that in turn exerted the pressure for its currency appreciation. The increased capital inflows strengthened the local currency, hence its stock prices, as is anticipated under a more flexible exchange rate. Both liberalisation of foreign exchange market and an opening up of local stock markets became more prone to contagion effects once their integration in the global financial markets intensified which can be observed from the dramatic fall in Chinese stock markets over the first half of 2008 due to the international stock market correction trigged by the American subprime loan crises. This area in particular should be awarded further research.

Table 5 Estimated Hot Money next inflow into China, 2002-2008, billion US dollars

Year	Amount	% of the increase in foreign currency reserve
2002	21.4 (2002-04)	3%
2003		6.5%
2004		13%
2005	339.7 (2005-07)	30.7%
2006		33.9%
2007		44.5%
2008 (up to the end of May)	119.5	44.5%

Source: from the Research Report "Hot Money inflow into China between 2005-2008", in 8 July 2008, China Galaxy Securities Company Limited, http://www.chinastock.com.cn.

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