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Analysis of Symmetric Impact of Exchange Rate on Far East-3 Gross Domestic Product : An Application of Co-Integration Time Series Analysis

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Abstract

Fluctuations in Exchange Rate do play a really vital role in impacting macro-economic variables, even in economic growth. And it does so via the channels of net exports and foreign investments. In this paper we have examined the effect of the fluctuations of exchange rate on the Gross Domestic Product in Far East Economies like China, Japan and Korea. All these economies are really progressive with quite excellent currencies to dominate the world economy. Their export and FDI are quite impressive as well. We have used time series co-integration technique namely Auto Regressive Distributed Lag model. From the analysis we found that there is long run relationship among the GDP and Exchange Rate, in both long run and short run. So for achieving the goal of sustainable growth, there should be stability in exchange rate management. For further research there should be some consideration for the flows of capital in multiple exchange rate regimes.

INTRODUCTION

The relationship between the real effective exchange rate and economic growth is undeniably significant, from both a descriptive and policy prescription standpoint. Changes in exchange rates are said to have an impact on almost every macroeconomic variable, including exports, imports, trade balance, consumption, investment, wages, interest rates, and so on. The literature on the relationship between the exchange rate and each macro variable is extensive, and the domestic output-exchange rate nexus is no exception. The real exchange rate (RER) is regarded as a barometer of an economy's competitiveness in international trade. If all other factors remain same, a higher real exchange rate makes a country's exports more expensive and imports relatively cheaper. As a result of influencing prices of exports and imports, RER movements cause changes in the allocation of domestic production and consumption between traded and non-traded goods. The literature on exchange rate and GDP relationship spot two channels through which the real exchange rate affects GDP: aggregate demand and aggregate supply. In the aggregate demand channel, a fall in the real effective exchange rate improves the international competitiveness of domestic goods, boosts net exports, and thus raises GDP. According to the aggregate supply channel, a depreciation of the real exchange rate raises the cost of production (and thus reduces GDP) and helps redistribute income in favor of the wealthy. Another possible channel may be the export led growth.

Dubas (2009) says in his study that there is a linear relationship between real exchange rate misalignment and economic growth. Razin and Collins (1997), on the other hand, find some evidence of non-linearity in the relationship between real exchange rate misalignment and economic growth. Studies from (Gala and Lucinda, 2006; Berg and Miao, 2010) on exchange rate and economic growth find the manipulation in exchange rate can accelerate economic growth which is particularly noteworthy in China. China is accused of manipulating the Renminbi's value against major currencies in order to finance its rapid economic growth (Bereau *et al.*, 2009). On the other hand Korea and Taiwan have experienced sluggish economic growth due to overvaluation of their currencies.

The exchange rate can highly influence the economic growth of a particular country through the exchange rate fluctuations while they are involved in international trade and investment (Abu Dalu *et al.* 2014). Their study was done on five Asian countries (Malaysia, Indonesia, Philippines, Thailand, and Singapore) which eventually motivated us to study on three economic giants of the Far East region (China, Japan and Korea). Though a number of researches are available on individual countries, especially on China regarding exchange rate fluctuations and economic growth, inclusion of a developed country like Japan and other developing country like Korea of the Far East region will give a better comparison.

This study attempts to employ Pesaran's co-integration statistical techniques known as Autoregressive Distributed Lag (ARDL), which have been known to offer a more robust alternative to measuring the impact of the exchange rate on their economic growth taking Far East countries (China, Japan & Korea) as sample of the study.

Following this introductory section he paper moves forward with the available literature on exchange rate and GDP relationship. The third section presents the methodology of the study. The empirical analysis of the panel data is presented in the fifth section followed by conclusion and appendix.

LITERATURE REVIEW

The literature review attempts to search for the economic and financial impacts of the earlier identified variables which are real effective exchange rate and gross domestic products. In brief, this chapter essentially attempts to highlight some major issues raised by the earlier researchers through their theoretical and empirical frameworks on the determinants of exchange rates and GDP. Relationship between exchange rate and macroeconomic variables is the most widely discussed issue in financial and monetary economics (Stavarek, 2013). Empirical evidence from countries of Latin America, Asia and Africa is often cited to support the view that the link between RER behaviour and economic performance is strong (Cottani et al, 1990). Economic scholars agree that the economic advancement and macroeconomic milestones could only be achieved through a well-managed exchange rate (Hussain *et al.* 2019). We can draw a lot of evidence from East Asian countries where a competitive exchange rate brought a positive change in their economic performance but this may not always be true or not permanent due to the vulnerability of different factors related to the economy. Exchange rate can influence the real GDP in a number of ways. Exchange rate creates balance in the export and import mechanism through cheaper export and encouraging local production hence creating employment for the citizens. Researchers always claim the poor economic conditions are the result of poorly managed exchange rates of the country (Rodrick, 2008). Most of the countries of the world value the management of real exchange rate which eventually avoids the overvaluation of the currency and drive a positive exchange rate-growth relationship (Johnson, Ostry, &

Subramanian, 2007; Kocenda, Maurel, & Schnabl, 2013; Rajan & Subramanian, 2006). Some researchers are very much concerned about the misrepresentation of currency values, they are trying to identify and show the necessity of a real exchange rate which can boost the GDP. Bahmani-Oskooee and Mohammadian (2017) have worked on identifying the relationship between currency devaluation and GDP growth. From their work we can bring some references about the researches on exchange rate and GDP relationship around the globe. Bahmani-Oskooee and Kutan (2008) studied this issue in East Europe and O.E.C.D. countries, for Asian countries the work of Bahmani-Oskooee *et al.* (2002) and Kim and Ying (2007) is well recognized, for Latin American economies by Mej?a-Reyes *et al.* (2010); and for Africa by Bahmani-Oskooee and Gelan (2013). Some other researchers have done a number of researches by taking the sample of a single country. Positive or negative relationship between E.R. and G.D.P. depends on aggregate demand and aggregate supply model. If Marshall-Lerner condition is satisfied, the devaluation of currency encourages the foreign buyers and which will eventually encourage the local processing and boost the GDP under. Malcolm and Tzvetana (1998), Joe (1999), Eduardo and Federico (2002) have studied the exchange rate and economic growth relationship in their separate studies and they discovered that less flexible exchange rate regimes were strongly associated with slower growth and higher output volatility in developing countries. In contrast, exchange rate regimes did not appear to have a significant impact on growth in industrial countries. Cooper (1971) and Krugman and Taylor (1978) were suspicious about the effect of devaluing currency in boosting the GDP as they assumed that the price of tradable products increases with the devaluation of currency. Edwards (1986) and Lizondo and Montiel (1989) further support the arguments adding the hypothesis of redistribution of income from wage class to entrepreneurs having excess savings. Mahmood *et al.* (2011) in their study guess the effect of exchange rate fluctuations on G.D.P., F.D.I., growth rate and openness using O.L.S. They applied G.A.R.C.H. model to compute volatility of exchange rate. Their finding shows a positive relationship between real exchange rate and other macroeconomic variables. Yang *et al.* (2013) have analyzed the impact of Chinese yuan appreciation on the economies of major trading partners. The results reveal in general, the Chinese currency appreciation can positively influence the GDP of their major trading partners and regions. Similar study was conducted by (Villavicencio and Bara, 2006) in Mexico, where increases in Peso leads to decreases in output and decreasing value of Peso motivates the expansion of output. Khan, Sattar, and Ur Rehman

(2012) claims a long-run relationship of exchange rate with trade, F.D.I. and G.D.P. but affirms no such relationship with inflation. Their study was based on Johansen's co-integration model over annual data range from 1980 to 2009. (Narayan, 2005) found more reliable results in using Johansen's co-integration with relatively smaller sample size. Anker and Bahmani-Oskooee (2001) studied the issue in the German economy where they found currency depreciation can expand domestic production. Nawaz (2012) in his study reveals an interesting finding, in the long term the exchange rate is less effective than in the short term. Kappler *et al.* (2013) investigated macroeconomic effects of exchange rate appreciation with panel data of 128 countries over the period 1960-2008 and found that currency appreciation has minimum effect on domestic production but has a strong effect on current account. Estimating through time series model, Kalyoncu *et al.* (2008) employed a simple linear relation between U.S. dollar and others found the exchange rate fluctuation is the key to increase or decrease of real output but Granger's cointegration method has failed to draw any long term relationship between two variables. An overvalued real exchange rate affects the pattern and level of production, the allocation and level of expenditure, the distribution and level of factor payments, the composition and size of trade flows, the level of international reserves and external debts, the parallel foreign exchange markets, currency substitution and capital flight (Tarawalie 2010). Fluctuations in exchange rate can indeed discourage trade and investment, which are significant for growth (Comunale 2015). (Calderon & Servén 2004), the more elastic the exchange rate administration is (and the more independent your monetary policy is), the more unpredictable growth happens. Aguirre & Calderon (2005) show that misalignments in the real effective exchange rate (REER) have even been shown to help predict GDP growth in a sample of developed and emerging countries. In the more recent literature on export-led growth, an undervalued exchange rate is demonstrated to have a positive effect on growth, whereas overvaluation is associated with low growth episodes as in Rodrik (2008). Furthermore, an examination of the relationship between REER misalignments and long-term growth has been provided by Gala & Lucinda (2006) and Vieira & MacDonald (2012). Results of Gala & Lucinda (2006) by using panel data setups indicate that a real depreciation, i.e. an increase in competitiveness, is linked to higher GDP growth. Eichengreen (2008) investigates the channel by which real effective exchange rate misalignments and exchange rate volatility can affect GDP growth in the long run.

Literature Review Table

Authors	**Countries**	**Time**	**Methods**	**Findings Frame**
(AbuDalu *et al.* 2014)	Malaysia, Indonesia, Philippines, Thailand, and Singapore	1991-2006	ARDL	Effect of Exchange rate fluctuations on economic growth.
(Rodrick, 2008)	188 Countries	1950-2004	Cross-Sectional Regressions	Poor economic condition is the result poorly managed ER.
(Johnson, Ostry, & Subramanian, 2007; Kocenda, Maurel, & Schnabl, 2013; Rajan & Subramanian, 2006)	Africa	1996-2005	Compare Current Performance with Benchmark	Management or RER to avoid overvaluation and drive economic growth.
Bahmani-Oskooee and Kutan (2008)	East Europe and O.E.C.D. countries	1980-2005	ADF test, KSS Test, ESTAR	Exchange rate and GDP relationships.
Bahmani-Oskooee *et al.* (2002) and Kim and Ying (2007)	Asian Countries	Pre-1997 Crisis Data		Are devaluations contractionary in Asia? Result : Contractionary.
Mejia-Reyes *et al.* (2010)	Latin American Economies	1950-2000	STR Modeling	Effects of changes in the real exchange rate on growth.
Bahmani-Oskooee and Gelan (2013)	22 African Countries			Devaluations are indeed expansionary in eight countries and contractionary in five countries.
Malcolm and Tzvetana (1998), Joe (1999), Eduardo and Federico (2002)	Kenys	1970-1996	Macroeconomic Model, as a Single-Equation Instrumental Variable Estimation, and as a Vector-Auto-Regression model	Less flexible exchange rate regimes were strongly associated with slower growth and higher output volatility in developing countries

Mahmood *et al.* (2011)	Pakistan	1975-2005	O.L.S	Effect of exchange rate fluctuations on G.D.P. Result : Positive.
(Villavicencio and Bara, 2006)	Mexico	1960-2005	Simple Model of Real Exchange Rate Determination	Increase in Peso leads to decreases in output and decreasing value of Peso motivates the expansion of output.
Khan, Sattar, and Ur Rehman (2012)	Pakistan	1980-2009	Unit root test, Johnson Co-Integration	Long-run relation-ship of exchange rate with trade, F.D.I. and G.D.P.
(Narayan, 2005)	China	1952-1998	Unit root test, Johnson Co-Integration, ARDL	Saving and investment are correlated for China for both the period of the fixed exchange rate and the entire sample period.
Anker and Bahmani-Oskooee (2001)	Germany	1980-2005	VAR and the Appropriate Cointegrating Vector Simultaneously	Currency depre-ciation can expand domestic production.
Nawaz (2012)	Pakistan	1972-2010	Granger Causality Test, Econometric Model	In the long term the exchange rate is less effective than in the short term.
Kappler *et al.* (2013)	128 Countries	1960-2008	Auto Regressive Model	Currency appreciation has minimum effect on domestic production but has a strong effect on current account.
Kalyoncu *et al.* (2008)	O.E.C.D. Countries	1980-2005	Augmented Dickey-Fuller (ADF), Econo-metric Model	Exchange rate fluctuation is the key to increase or decrease of real out-put but Granger's cointegration

				method has failed to draw any long term relationship between two variables.
Comunale (2015)	EU Countries	1994-2012	Heterogeneous, Cointegrated Panel Frame-works	Exchange rate can discourage trade and investment, which are signifi-cant for growth.
Calderon (2004)	100 Countries	1960-2000	Econometric Analysis	More elastic the exchange rate, the more unpredictable growth happens.
Aguirre & Calderon (2005)	G-20 Countries	1980-2006	BEER Frame-work, Panel Unit Root and Cointe-gration Tests, Unit Root Tests, Cointegration Tests	Misalignments in the Real Effective Exchange Rate (REER) have even been shown to help predict GDP growth in a sample of developed and emerging countries.
Rodrik (2008)	Selected Developing Countries including China	1960-1990	Cross Sectional Rregression	Undervalued ex-change rate is demonstrated to have a positive effect on growth, whereas overvalu-ation is associated with low growth.
Gala & Lucinda (2006) and Vieira & MacDonald (2012). Results of Gala & Lucinda (2006)	58 Developing Countries	1960-1998	PPP Deviations and Balassa-Samuelson Adjustments	An increase in competitiveness, is linked to higher GDP growth.
Eichengreen (2008)	Emerging & Developing Countries	1992-2005	Cross-Sectional Regressions	Real effective exchange rate mis-alignments and exchange rate volatility can affect GDP growth in the long run.

RESEARCH GAP

In the literature review, it has been described clearly that nexus between exchange rate and GDP is a very much well researched area. Numerous researchers have worked on this particular topic. But this topic has not been researched particularly on Far Eastern Economies in a comparative manner. As per UNCTAD, China has continuously raked to be the first in merchandise exports for almost last two decades. Japan is a member of G-7 bloc. South Korea is in the bloc of G-20. So a comparative nexus between exchange rate and GDP on these three economies is an interesting space on which this particular paper has been worked on.

DATA AND METHODOLOGY

As aforementioned, we have used yearly time series data from three Far East countries namely China, Japan and South Korea. Data has been collected from international organizations' database like World Bank, IMF as well as countries' national archives. For Japan 1980 to 2020, for South Korea 1990 to 2020, for China 1980 to 2020 data has been used for the analysis. The variables have been described in Appendix 7.

Unit Root Tests

The common rule for cointegration techniques is that the time-series properties of each individual variable in discussion need to be investigated. There are various cointegration techniques. We need to identify that variables are stationary at level, I(0), or they must be stationary after differencing, I(d), if they are not stationary at level. Here, d indicates that, to get to the stationary point the number of times the variables in the model has been differentiated. It is mandatory as if we cannot achieve the non-stationary variables, it will provide a false relationship. If it is possible to achieve the non-stationary variables and set the model with them, surely the model will provide a proper co-integration output and define appropriate relationship.

To know whether unit root exists, the highly suggested method is the ADF (Augmented Dickey-Fuller) test. It involves estimating a form of the following equation by OLS :

$$\Delta x_t = \gamma_0 + \gamma_1 t + \phi x_{t-1} + \varphi \Delta x_{t-1} + ... \varphi \Delta x_{t-q} + \varepsilon_t \quad (1)$$

Here, Δ means the difference. The *t*-statistic for the calculated coefficient ϕ is the Augmented Dickey-Fuller (ADF) statistic. Interestingly, The ADF statistic does not have a usual student-t distribution; but it must be weighed against the specific tables such as those have been provided in MacKinnon (MacKinnon, 1996). The above equation (1) involves the most usual specification with q differences or lags. The outcomes below for variables are hence obtained by beginning with q equal to four (MacKinnon, 1996) and then scientifically excluding insignificant variables (may be in lags, or in constant, and/or even in trend) making certain that there is no serial correlation in the residuals. After the chosen equation has been accomplished in this manner, we get the *t*-statistic that gives the ADF statistics in the empirical analysis. In here we are experiencing a sign of the time-series properties of the individual time series variable, but if we find the variables to be non-stationary in levels, we proceed for the differencing to achieve the stationary in the variables and eventually we get the opportunity for progressing to the co-integration techniques.

The Phillips-Perron test doesn't include the lagged differences, otherwise it is also based on the same regression as the ADF test. The t-statistic of the particular coefficient in discussion is corrected for serial correlation by applying Newey-West (Newey & West, 1987) procedure from the adjustment of the standard errors.

The ARDL Cointegration Approach

To determine long term relationships among variables under study (Pesaran and Pesaran, 1997; and Pesaran *et al.*, 2001), the autoregressive distributed lag or ARDL bound test (ARDL) is one the widely used cointegration techniques. To estimate both long and short run relations among numerous variables of interest the Autoregressive Distributed Lag model is a dynamic specification. This model includes lagged values of the dependent and explanatory variables as well as contemporaneous values of explanatory variables. Among all other advantages, the main advantage of ARDL model is in its flexibility. The model gives better output when the sample size T is small. This method does not classify the variables as I (1) and I (0) by developing bands of critical values which identifies the variables as being stationary or non-stationary processes. In ARDL model an alternative test for examining a long-run relationship irrespective of whether the underlying variables are purely I(0) or I(1), even fractionally integrated, which doesn't comparable to other techniques. In other cointegration methods (e.g., Johansen's procedure) certain pre-testing for unit roots and the underlying variables to be integrated in the same order. In addition to that, previously used cointegration methods suffer from the problems of endogeneity, whereas, ARDL method can distinguish dependent and explanatory variables. That's why the estimates gained from the ARDL model are much more efficient and avoid biasness, as if they avoid the problems that may arise in the presence serial correlation and endogeneity. The problem in confirming the order of VAR, optimum number of lags and many others found in Johansen cointegration could easily be overcome by ARDL. The ARDL method has four steps: They are, (1) to examine the existence of cointegration using the bounds testing procedure; (2) To estimate the coefficients 17 of the long run relationships identified in the first step; (3) To estimate the short run dynamic coefficients; (4) The fourth stage involves testing for the stability of the model, by using the CUSUM and CUSUMSQ tests (Pesaran and Pesaran 1997; Pesaran, *et al.* 2001). According to Pesaran and Pesaran (1997), the ARDL procedure is represented by the following equation :

As per the equation provided by Pesaran and Pesaran (1997), the Auto Regressive Distributed Lag model may be showed by the following equations :

$$\varphi(L, p)y_t = \sum_{i=1}^{k} \beta_i (L, q_i) X_{it} + \delta^{w_t} + u_t \quad (2)$$

Here,

$$\varphi(L, p)y_t = 1 - \varphi_1 L + \varphi_2 L^2 - .... \varphi_p L^p \quad (3)$$

And

$$\beta_i (L, pi)X_{it} = 1 - \beta_{i1} L^2 - \beta_{i2} L - .... \beta_{iqi} L^{qi} \quad i = 1, 2...., k \quad (4)$$

Here *yt* refers the dependent variable but *xit* is the i dependent variables. Lag operator has been presented by *L*. Wt is the SX_1 vector which is representing the deterministic variables employed, including dummy variables, intercept terms, other exogenous variables and time trends. There has been two methods namely, Akaike Information Criterion (AIC) and Schwarz Bayesian Criteria (SBC), to determine the optimum lag length. It is done so by minimizing the value of either of one of the methods namely Akaike Information Criterion(AIC) or Schwarz Bayesian Criteria (SBC). Then by applying the proper ARDL model, one could obtain the long run coefficients and their asymptotic standard errors. To pursue the long run elasticity we can pursue the following process :

$$\hat{\theta} - \frac{\hat{\beta}_{i0} + \hat{\beta}_{i1} - \cdots + \hat{\beta}_{ip}}{1 - \hat{\varphi}_1 + \hat{\varphi}_2 + \cdots + \hat{\varphi}_p} \quad \forall \quad i - 1,2,\ldots,k \quad (5)$$

We could explain the long run co-integrating vector by the following :

$$yt - \hat{\theta}_0 - \hat{\theta}_1 x_{1t} - \hat{\theta}_2 x_{2t} - \cdots - \hat{\theta}_k x_{kt} - \varepsilon_t \quad \forall \quad i - 1,2,\ldots,n \quad (6)$$

In this particular equation, the constant term will be referred as following :

$$\hat{\theta} = \frac{\hat{\beta}_0}{1 - \hat{\varphi}_1 + \hat{\varphi}_2 - \cdots + \hat{\varphi}_p} \quad (7)$$

Now if we rearrange the equation (2) by representing the terms of lagged levels and first difference of y_t, x_{1t}, x_{2t}, ..., x_{kt} and w_t for getting the short run form of the Auto Regressive Distributed Lag; it will be as follows :-

$$\Delta y_t = -\varphi(1,\hat{p})EC_{t-1} + \sum_{i=1}^{k} \beta_{i0}\,\Delta x_{1t}\delta'\Delta W_t - \sum_{j=1}^{\beta-1} \varphi^* y_{t-j} + \sum_{l=1}^{k}\sum_{j=1}^{\hat{q}_{i-1}} \beta_{ij} * \Delta x_{i,t-j} + u_t \quad (8)$$

And at the final stage the error correction term can be easily defined by following manner :

$$EC_t = y_t - \sum_{i=1}^{k} \hat{\theta}_i\, x_{it} - \psi' w_t \quad (9)$$

In equation number (8), dynamic coefficients in short run have been represented by φ *, δ' and β_{ij}. On the other hand, the speed of adjustment has been denoted by φ (1, $\hat{p}$).

Empirical Analysis

Before estimating Auto Regressive Distributed Lag model, we need to check for stationarity of the variables via Augmented Dickey-Fuller Test and Philips-Perron Test for being sure that none of the variables is integrated of second order. Because bound testing procedure gets broken down (Pesaran *et al.*, 2001). The output of unit root tests namely ADF and PP Test has been presented in Table A2.1, A2.2, A2.3. The results show that the variables are stationary in level and first difference that means I(0), I(1) or both. The level of significance is 5%. The interesting matter is that the most macroeconomic variables have the propensities of being stationary at level that means I(0), if not it usually gets stationary at first difference, I(1). That's why ARDL method usually does not need pre-testing for the unit root. Moreover, this method considers enough lags of the variables that serve as a proper instrument to remove the endogeneity issue (Bahmani-Oskooee & Hajilee, 2010). Pesaran *et al.* (2001) describe this instrument as an approach of general method, because it provides very flexible choice for the dynamic lag structure and also allow for short run feedbacks.

The long run and short run test results presented in Appendix 3, Appendix 4, Appendix 5 show that F value is 13.26529 For China, 8.634658 For Korea, 2.75317 For Japan. For China and Korea there must be a co-integration relationship at 5% level of significance as the F value lie above upper bound critical value at 5%. For Japan, it's inconclusive at 10% level of significance. Though for the presence of co-integration relationship, the co-efficient of ECM term should be statistically significant. Apart from that it must lie between -1 to 0. It will help to check and test the speed of adjustment back to equilibrium after a shock occurs (Banerjee *et al.*, 1998). The ECM terms presented in Tables A6.1, A6.2, A6.3 prove that there must be long-run relationship between dependant and explanatory variables as the ECM terms are statistically significant.

The long run estimates have been presented in Appendix 3, Appendix 4, Appendix 5. It shows that the coefficient of Real Effective Exchange Rate is significant for China but is insignificant for Japan and Korea. Here the statistical insignificance might have happened because of the assumption of symmetric effect of devaluation and appreciation in linear A.R.D.L.

The stability tests' outputs have been showed in the figures of Appendix 7. They prove that the models are stable.

CONCLUSION

The fluctuations in Exchange Rate do play a quite vital role to influence the macroeconomic grwoth through the foreign trade and FDI. This study evaluates the effect of E.R. changes on G.D.P. in a industrially progressed export oriented countries like China, Japan and Korea. The study has been inspired the theory of aggregate demand and aggregate supply by Bahmani-Oskooee and Mohammadian (2017) but we have focused on Demand side only. If we would include the Aggregate Supply side in the research, it would reduce degree of freedom for a sample of small size in a dynamic model as in the present model of this paper. As in this paper we are having a problem of longer span time series variables of our interest in the case of Japan, Korea and China. Moreover it is going to help us to get rid of the multicollinearity problem among the dependent variables and very complex kind of inter-connections between the two forces namely aggregate demand and aggregate supply. From the analysis it has been assured that weak currency leads to unfavorable trade and eventually hampers economic growth and vice versa. So for achieving a sustainable and stable growth, exchange rate should be quite stable and stake holders should target for stronger domestic currency. For future studies, supplies side elements may be tested over longer data and analyze the 'Sudden-Stop Hypothesis'.

References

AbuDalu, *et al.* (2014), *Int. J. Econ. Manag. Sci.*, 3 : 2 Http://dx.doi.org/10.4172/2162-6359.1000174

Aguirre, A.; and Calderon, C. (2005), "Real Exchange Rate Misalignments and Economic Performance", Central Bank of Chile, Economic Research Division.

Anker, P.; and Bahmani-oskooee, M. (2001), On the Relationship Between the Value of the Mark and German Production, *Applied Economics,* 33(12), 1525-1530.

Bahmani-Oskooee, M.; and Rhee, H. J. (1997), Response of Domestic Production to Depreciation in Korea : An Application of Johansen's Cointegration Methodology, *International Economic Journal,* 11(4), 103-112

Bahmani-Oskooee, M.; and Hajilee, M. (2010), On the Relation Between Currency Depreciation and Domestic Investment, *Journal of Post Keynesian Economics,* 32(4), 645-660.

Bahmani-Oskooee, M.; and Mohammadian, A. (2017), Asymmetry Effects of Exchange Rate Changes on Domestic Production in Japan, *International Review of Applied Economics,* 31(6), 774-790.

Bahmani-Oskooee, M.; Kutan, A. M.; and Zhou, S. (2008), Do Real Exchange Rates Follow a Non-linear Mean Reverting Process in Developing Countries?, *Southern Economic Journal,* 74(4), 1049-1062.

Bahmani-Oskooee, M.; Chomsisengphet, S.; and Kandil, M. (2002), Are Devaluations Contractionary in Asia?, *Journal of Post Keynesian Economics,* 25(1), 69-82.

Bahmani-Oskooee, M.; and Gelan, A. (2013), Are Devaluations Contractionary in Africa?, *Global Economic Review,* 42(1), 1-14.

Banerjee, A.; Dolado, J.; and Mestre, R. (1998), Error-correction Mechanism Tests for Cointegration in a Single-equation Framework, *Journal of Time Series Analysis,* 19(3), 267-283.

Calderon, C. A.; and Servén, L. (2004), The Effects of Infrastructure Development on Growth and Income Distribution, Available at SSRN 625277.

Comunale, M. (2015a), "Long-run Determinants and Misalignments of the Real Effective Exchange Rate in the EU", *Bank of Lithuania Working Paper Series,* (2015, No. 18)

Cottani, J. A.; Cavallo, D. F.; and Khan M. S. (1990), "Real Exchange Rate Behavior and Economic Performance in LDCS", *Economic and Cultural Change.*

Cooper, R. N. (1971), Currency Devaluation in Developing Countries, *Essay in International Finance,* No. 86, New Jersey : International Finance Section, Princeton University.

Eduardo, Federico (2002), To Float or to Trail : Evidence on the Impact of Exchange Rate Regimes, Business School, Universidad Torcuato Di Tella.

Edwards, S. (1986), Are Devaluation Contractionary?, *The Review of Economic and Statistics,* 68(3), 501-508.

Eichengreen, B. (2008), "The Real Exchange Rate and Economic Growth", *Commission on Growth and Development Working Paper,* No. 4, The World Bank, 2008.

Gala, P.; and Lucinda, C. R. (2006), "Exchange Rate Misalignment and Growth : Old and New Econometric Evidence", *Revista Economia,* Pp. 165-87.

Ibrar Hussain; Jawad Hussain; Arshad Ali Khan; and Yahya Khan (2019), An Analysis of the Asymmetric Impact of Exchange Rate Changes on G.D.P. in Pakistan : Application of Non-linear A.R.D.L., *Economic Research-ekonomska Istra•ivanja,* 32 : 1, 3100-3117, Doi: 10.1080/1331677x.2019.1653213

Joe, T. (1999) Economic Growth and Exchange Rate Uncertainty, *Applied Economics,* 31 : 347-358.

Johnson, S.; Ostry, J.; and Subramanian, A. (2007), The Prospects for Sustained Growth in Africa : Benchmarking the Constraints, IMF Working Paper 07/52, Washington : International Monetary Fund (March).

Kalyoncu, H.; Artan, S.; Tezekici, S.; and Ozturk, I. 2008, "Currency Devaluation and Output Growth : An Empirical Evidence From Oecd Countries", *International Research Journal of Finance and Economics,* Vol. 14, pp. 232-238.

Kappler, M.; Reisen, H.; Schularick, M.; and Turkisch, E. 2013, 'The Macroeconomic Effects of Large Exchange Rate Appreciations', *Open Economies Review,* Vol. 24, No. 3, Pp. 471-494.

Khan, R. E. A.; Sattar, R.; and Ur Rehman, H. (2012), Effectiveness of Exchange Rate in Pakistan : Causality Analysis, *Pakistan Journal of Commerce and Social Sciences,* 6(1), 83-96.

Kim, Y.; and Ying, Y. H. (2007), An Empirical Assessment of Currency Devaluation in East Asian Countries, *Journal of International Money and Finance,* 26(2), 265-283.

Kocenda, E.; Maurel, M.; and Schnabl, G. (2013), Short- and Long-term Growth Effects of Exchange Rate Adjustment, *Review of International Economics,* 21(1), 137-150. Doi : 10.1111/ Roie.12025

Mackinnon, J. G. (1996), Numerical Distribution Functions for Unit Root and Cointegration Tests, *Journal of Applied Econometrics,* 11(6), 601-618. https://doi.org/https://doi.org/10.1002/(sici)1099-1255(199611)11:6<601::aid-jae417>3.0.co;2-t

Mahmood, I.; Ehsanullah, M.; and Ahmed, H. (2011), Exchange Rate Volatility & Macroeconomic Variables in Pakistan, *Business Management Dynamics,* 1(2), 11-22.

Malcolm, F. M.; and Tzvetana, R. (1998), *Exchange Rates and Economic Growth in Kenya : An Econometric Analysis,* Development Discussion Paper No. 651.

Narayan, P. K. (2005), The Saving and Investment Nexus For China : Evidence from Cointegration Tests, *Applied Economics,* 37(17), 1979-1990.

Nawaz, M. (2012), The Impact of Exchange Rate on Output Level : Bounds Testing Approach for Pakistan, *The Pakistan Development Review,* 51(4ii), 419-433.

Newey, W.; and West, K. (1987), A Simple, Positive Semi-definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix, *Econometrica,* 55, 703-708

OU, P.; and Wang, H. (2013), Volatility Modelling and Prediction by Hybrid Support Vector Regression with Chaotic Genetic Algorithms, *Int Arab J Inf Technol,* 11(3), 287-292.

Patton, A. J. (2011), Volatility Forecast Comparison Using Imperfect Volatility Proxies, *Contemp Acc Res*, 20, 551-578 smith.

Pesaran, M. H.; and Pesaran, B. (1997), Working with Microfit 4.0 : Interactive

Econometric Analysis [windows Version]. Oxford: Oxford University Press.

Pesaran, M. H.; Shin, Y.; and Smith, R. J. (2001), Bounds Testing Approaches to the Analysis of Level Relationships, *Journal of Applied Econometrics,* 16(3), 289-326.

Rajan, R. G.; and Subramanian, A. (2006), Aid, Dutch Disease, and Manufacturing Growth, Washington : Peterson, Institute for International Economics.

Rodrick, D. (2008), The Real Exchange Rate and Economic Growth, *Brookings Papers on Economic Activity,* 2008(2), 365-412.

Stavarek, D. (2013), Cyclical Relationship Between Exchange Rates and Macro-Fundamentals in Central and Eastern Europe, *Economic Research - Ekonomska Istrazivanja,* 26(2), 83-98. Doi : 10.1080/1331677x.2013.11517608

Tarawalie, A. B. (2010), Real Exchange Rate Behaviour and Economic Growth : Evidence from Sierra Leone, SAJEMS NS 13 (2010) No. 1.

Vieira, F.; and Macdonald, R. (2012), "A Panel Data Investigation of Real Exchange Rate Misalignment and Growth", *Estudios Economicos*, 42(3), 2012, pp. 433-456.

Villavicencio, A. L.; and Bara, J. L. R. (2006), The Short and Long-Run Determinants of the Real Exchange Rate in Mexico (No. WPDEA0606).

Appendix 1

Descriptive statistics

Table A1.1

Japan

	LN_GDP_JP	LN_REER_JP	LN_BM_JP	LN_GEX_JP
Mean	34.4625	4.557929	2.807978	33.73776
Median	34.57736	4.604061	2.806337	33.81015
Maximum	34.95538	4.907666	3.015438	33.95134
Minimum	33.49015	4.240159	2.606073	33.24239
Std. Dev.	0.368703	0.188644	0.139977	0.200269
Skewness	-1.194225	-0.034286	0.051585	-1.156707
Kurtosis	3.466971	1.827114	1.462454	3.160815
Jarque-Bera	10.11804	2.35812	4.056766	9.186982
Probability	0.006352	0.307568	0.131548	0.010117
Sum	1412.962	186.8751	115.1271	1383.248
Sum Sq. Dev.	5.437672	1.42346	0.783737	1.604302
Observations	41	41	41	41

Table A1.2
Korea

	LN_GDP_KR	LN_REER_KR	LN_BM_KR	LN_GEX_KR
Mean	34.194	4.813049	2.555435	34.60779
Median	34.56	4.878909	2.554297	34.68299
Maximum	35.70188	5.102513	2.899863	35.1534
Minimum	31.86088	4.517585	2.306514	33.74944
Std. Dev.	1.224762	0.169675	0.169959	0.426107
Skewness	-0.576489	-0.211726	0.17389	-0.454133
Kurtosis	1.879074	1.627615	1.829798	2.002679
Jarque-Bera	3.340035	2.664388	1.925	2.350311
Probability	0.188244	0.263898	0.381937	0.308771
Sum	1060.014	149.2045	79.21849	1072.842
Sum Sq. Dev.	45.0013	0.863688	0.866584	5.447006
Observations	31	31	31	31

Table A1.3
China

	LN_GDP_CN	LN_REER_CN	LN_BM_CN	LN_GEX_CN
Mean	29.92042	4.727585	30.4757	2.691226
Median	30.2408	4.616197	30.47888	2.682853
Maximum	33.00057	5.597424	32.14273	2.823664
Minimum	25.84192	4.255931	28.59907	2.525559
Std. Dev.	2.243597	0.323478	1.111058	0.081743
Skewness	-0.328917	1.291555	-0.081626	-0.027384
Kurtosis	1.853642	3.912535	1.749856	1.914749
Jarque-Bera	2.984259	12.82134	2.715415	2.017148
Probability	0.224893	0.001644	0.25725	0.364739
Sum	1226.737	193.831	1249.504	110.3403
Sum Sq. Dev.	201.349	4.185528	49.37797	0.267274
Observations	41	41	41	41

Appendix 2
Unit Root Tests

Table A2.1
Unit Root Test - Japan

UNIT ROOT TEST TABLE (PP)					
	At Level	LN_GDP_JP	LN_REER_JP	LN_BM_JP	LN_GEX_JP
With Constant	t-Statistic	-3.6958	-1.7117	-0.0192	-4.7558
	Prob.	0.0079	0.4178	0.9511	0.0004
		***	n0	n0	***
With Constant & Trend	t-Statistic	-2.7383	-1.9937	-2.2173	-1.571
	Prob.	0.2277	0.5869	0.4675	0.7867
		n0	n0	n0	n0
Without Constant & Trend	t-Statistic	2.9081	0.0222	1.8962	2.673
	Prob.	0.9987	0.684	0.9846	0.9976
		n0	n0	n0	n0
At First Difference					
		d(LN_GDP_JP)	d(LN_REER_JP)	d(LN_BM_JP)	d(LN_GEX_JP)
With Constant	t-Statistic	-3.7198	-4.8995	-4.119	-2.8652
	Prob.	0.0075	0.0003	0.0026	0.0587
		***	***	***	*
With Constant & Trend	t-Statistic	-4.0055	-6.5448	-4.1874	-4.4751
	Prob.	0.0167	0	0.0106	0.0051
		**	***	**	***
Without Constant & Trend	t-Statistic	-2.7498	-4.9877	-3.7211	-2.5665
	Prob.	0.0072	0	0.0005	0.0116
		***	***	***	**

Contd.

Table A2.1
Unit Root Test - Japan (Continued)

UNIT ROOT TEST TABLE (ADF)					
	At Level	LN_GDP_JP	LN_REER_JP	LN_BM_JP	LN_GEX_JP
With Constant	t-Statistic	-4.5344	-1.6712	0.3746	-5.0094
	Prob.	0.0008	0.4378	0.9793	0.0002
		***	n0	n0	***
With Constant & Trend	t-Statistic	-3.1017	-2.3394	-3.2662	-1.5726
	Prob.	0.1198	0.404	0.0874	0.7861
		n0	n0	*	n0
Without Constant & Trend	t-Statistic	4.759	-0.078	2.6216	3.9884
	Prob.	1	0.6501	0.9973	0.9999
		n0	n0	n0	n0
At First Difference					
		d(LN_GDP_JP)	d(LN_REER_JP)	d(LN_BM_JP)	d(LN_GEX_JP)
With Constant	t-Statistic	-3.7433	-4.6778	-4.08	-2.9917
	Prob.	0.0071	0.0006	0.0029	0.0445
		***	***	***	**
With Constant & Trend	t-Statistic	-3.933	-5.2648	-4.1428	-4.4685
	Prob.	0.0199	0.0007	0.0119	0.0052
		**	***	**	***
Without Constant & Trend	t-Statistic	-2.9542	-4.7485	-3.6282	-2.733
	Prob.	0.0042	0	0.0006	0.0076
		***	***	***	***

Notes : (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1%. and (no) Not Significant

*MacKinnon (1996) one-sided p-values.

Table A2.2
Unit Root Test - Korea

UNIT ROOT TEST TABLE (PP)					
	At Level	LN_GDP_JP	LN_REER_JP	LN_BM_JP	LN_GEX_JP
With Constant	t-Statistic	-2.5703	-2.1652	1.2092	-15.542
	Prob.	0.1101	0.2224	0.9975	0
		n0	n0	n0	***
With Constant & Trend	t-Statistic	-0.7679	-2.0645	-2.568	-0.9242
	Prob.	0.9577	0.5437	0.2962	0.9398
		n0	n0	n0	n0
Without Constant & Trend	t-Statistic	4.4331	-0.0245	2.8284	6.3583
	Prob.	1	0.6666	0.9982	1
		n0	n0	n0	n0
At First Difference					
		d(LN_GDP_JP)	d(LN_REER_JP)	d(LN_BM_JP)	d(LN_GEX_JP)
With Constant	t-Statistic	-3.4679	-3.732	-5.6773	-4.5825
	Prob.	0.0165	0.0088	0.0001	0.001
		**	***	***	***
With Constant & Trend	t-Statistic	4.012	-4.2156	-6.0857	-16.6907
	Prob.	0.0196	0.0124	0.0001	0
		**	**	***	***
Without Constant & Trend	t-Statistic	-2.0016	-3.8514	-4.698	-2.4684
	Prob.	0.045	0.0004	0	0.0155
		**	***	***	**

Contd.

Table A2.2
Unit Root Test - Korea (Continued)

UNIT ROOT TEST TABLE (ADF)					
	At Level	LN_GDP_JP	LN_REER_JP	LN_BM_JP	LN_GEX_JP
With Constant	t-Statistic	-2.82	-2.9056	0.9644	-4.4456
	Prob.	0.0674	0.0569	0.995	0.0017
		*	*	n0	***
With Constant & Trend	t-Statistic	-0.6464	-2.8392	-2.6432	-1.0835
	Prob.	0.9682	0.1957	0.2654	0.9128
		n0	n0	n0	n0
Without Constant & Trend	t-Statistic	2.4261	-0.0334	2.6526	7.3934
	Prob.	0.9951	0.6636	0.9972	1
		n0	n0	n0	n0
At First Difference					
		d(LN_GDP_JP)	d(LN_REER_JP)	d(LN_BM_JP)	d(LN_GEX_JP)
With Constant	t-Statistic	-3.4804	-3.9333	-5.6787	-4.596
	Prob.	0.016	0.0054	0.0001	0.001
		**	***	***	***
With Constant & Trend	t-Statistic	-4.012	-3.9035	-6.0878	-5.8733
	Prob.	0.0196	0.0249	0.0001	0.0004
		**	**	***	***
Without Constant & Trend	t-Statistic	-2.1875	-4.01	-0.6338	-2.8173
	Prob.	0.0299	0.0003	0.4325	0.0071
		**	***	n0	***

Notes : (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1%. and (no) Not Significant

*MacKinnon (1996) one-sided p-values.

Table A2.3

Unit Root Test - China

UNIT ROOT TEST TABLE (PP)					
	At Level	LN_GDP_JP	LN_REER_JP	LN_BM_JP	LN_GEX_JP
With Constant	t-Statistic	-3.3415	-3.0155	-1.8603	-1.6789
	Prob.	0.0194	0.0419	0.347	0.434
		**	**	n0	n0
With Constant & Trend	t-Statistic	0.1927	-4.0712	0.7695	-2.809
	Prob.	0.9972	0.014	0.9996	0.2026
		n0	**	n0	n0
Without Constant & Trend	t-Statistic	6.9949	-1.356	13.5203	0.7565
	Prob.	1	0.1596	1	0.8735
		n0	n0	n0	n0
At First Difference					
		d(LN_GDP_JP)	d(LN_REER_JP)	d(LN_BM_JP)	d(LN_GEX_JP)
With Constant	t-Statistic	-2.052	-4.8459	-2.8164	-3.8367
	Prob.	0.2645	0.0003	0.0652	0.0055
		n0	***	*	***
With Constant & Trend	t-Statistic	-3.1998	-6.5883	-3.304	-3.7474
	Prob.	0.0993	0	0.0806	0.0307
		*	***	*	**
Without Constant & Trend	t-Statistic	-0.8913	-4.8312	-0.6943	-3.843
	Prob.	0.3237	0	0.4096	0.0003
		n0	***	n0	***

Contd.

Table A2.3
Unit Root Test - China (Continued)

UNIT ROOT TEST TABLE (ADF)					
	At Level	LN_GDP_JP	LN_REER_JP	LN_BM_JP	LN_GEX_JP
With Constant	t-Statistic	-2.6055	-3.2626	-2.1064	-2.7957
	Prob.	0.1005	0.0244	0.2434	0.0681
		n0	**	n0	*
With Constant & Trend	t-Statistic	-0.8481	-2.0979	0.172	-4.2878
	Prob.	0.9519	0.5312	0.9969	0.0082
		n0	n0	n0	***
Without Cons-tant & Trend	t-Statistic	1.3624	-1.356	1.3463	0.5769
	Prob.	0.9541	0.1596	0.9525	0.8366
		n0	n0	n0	n0
At First Difference					
		d(LN_GDP_JP)	d(LN_REER_JP)	d(LN_BM_JP)	d(LN_GEX_JP)
With Constant	t-Statistic	-1.9725	-4.85	-1.8082	-4.3564
	Prob.	0.2973	0.0003	0.3709	0.0014
		n0	***	n0	***
With Cons-tant & Trend	t-Statistic	-3.1966	-5.4764	-3.748	-4.2836
	Prob.	0.1	0.0003	0.031	0.0085
		*	***	**	***
Without Cons-tant & Trend	t-Statistic	-0.9169	-4.8287	-0.8727	-4.3493
	Prob.	0.313	0	0.3312	0.0001
		n0	***	n0	***

Notes : (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1%. and (no) Not Significant

*MacKinnon (1996) one-sided p-values.

Appendix 3

ARDL Long Run Form, Short Run Form and Bound Test- Japan

Conditional Error Correction Regression				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-2.501569	4.070466	-0.614566	0.544
LN_GDP_JP(-1)*	-0.170196	0.100566	-1.692379	0.1021
LN_REER_JP**	0.105466	0.075446	1.397891	0.1735
LN_BM_JP(-1)	0.021981	0.11542	0.190446	0.8504
LN_GEX_JP(-1)	0.233266	0.206345	1.13047	0.2682
D(LN_GDP_JP(-1))	0.127806	0.179471	0.712129	0.4825
D(LN_GDP_JP(-2))	0.276117	0.182285	1.514749	0.1415
D(LN_GDP_JP(-3))	0.288576	0.191325	1.508302	0.1431
D(LN_BM_JP)	-2.001289	0.757072	-2.643461	0.0135
D(LN_GEX_JP)	-1.435945	0.606358	-2.368146	0.0253

* p-value incompatible with t-Bounds Distribution.

** Variable interpreted as Z = Z (-1) + D(Z).

Levels Equation

Case 2 :

Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_REER_JP	0.619672	0.44584	1.389897	0.1759
LN_BM_JP	0.129153	0.667737	0.193419	0.8481
LN_GEX_JP	1.370571	0.563225	2.433432	0.0219
C	-14.69812	18.04342	-0.814597	0.4224

EC = LN_GDP_JP - (0.6197*LN_REER_JP + 0.1292*LN_BM_JP + 1.3706 *LN_GEX_JP -14.6981)

F-Bounds Test	**Null Hypothesis : No Levels Relationship**			
Test Statistic	**Value**	**Signif.**	**I(0)**	**I(1)**
		Asymptotic : n=1000		
F-statistic	2.75317	10%	2.37	3.2
K	3	5%	2.79	3.67
		2.50%	3.15	4.08
		1%	3.65	4.66
Actual Sample Size	37	Finite Sample : n=40		
		10%	2.592	3.454
		5%	3.1	4.088
		1%	4.31	5.544
		Finite Sample : n=35		
		10%	2.618	3.532
		5%	3.164	4.194
		1%	4.428	5.816

Appendix 4

ARDL Long Run Form, Short Run Form and Bound Test- Korea

Conditional Error Correction Regression				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-14.85511	9.565602	-1.55297	0.1464
LN_GDP_KR(-1)*	-0.313951	0.104675	-2.99929	0.0111
LN_REER_KR(-1)	-0.100594	0.089101	-1.129	0.281
LN_BM_KR(-1)	-0.193762	0.298663	-0.64877	0.5287
LN_GEX_KR(-1)	0.770306	0.385141	2.000065	0.0686
D(LN_GDP_KR(-1))	0.535602	0.111009	4.824853	0.0004
D(LN_GDP_KR(-2))	-0.116065	0.106043	-1.09451	0.2952
D(LN_REER_KR)	0.089548	0.125899	0.711265	0.4905
D(LN_BM_KR)	0.846128	0.525719	1.609466	0.1335
D(LN_BM_KR(-1))	-0.078883	0.483517	-0.16314	0.8731
D(LN_BM_KR(-2))	2.5622	0.755046	3.393433	0.0053
D(LN_GEX_KR)	0.732739	0.893616	0.81997	0.4282
D(LN_GEX_KR(-1))	-1.058699	0.598196	-1.76982	0.1021
D(LN_GEX_KR(-2))	2.041862	0.902026	2.263641	0.0429
D(LN_GEX_KR(-3))	-2.869353	0.485723	-5.90739	0.0001

* p-value incompatible with t-Bounds distribution.

Levels Equation

Case 2 :

Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_REER_KR	-0.320414	0.225067	-1.42364	0.18
LN_BM_KR	-0.617174	0.961694	-0.64176	0.5331
LN_GEX_KR	2.453586	0.544808	4.503583	0.0007
C	-47.31661	17.60271	-2.68803	0.0197

EC = LN_GDP_KR – (-0.3204*LN_REER_KR – 0.6172*LN_BM_KR + 2.4536*LN_GEX_KR – 47.3166)

F-Bounds Test	**Null Hypothesis : No Levels Relationship**			
Test Statistic	**Value**	**Signif.**	**I(0)**	**I(1)**
		Asymptotic : n = 1000		
F-statistic	8.634658	10%	2.37	3.2
K	3	5%	2.79	3.67
		2.50%	3.15	4.08
		1%	3.65	4.66
Actual Sample Size	27	Finite Sample : n = 35		
		10%	2.618	3.532
		5%	3.164	4.194
		1%	4.428	5.816
		Finite Sample : n = 35		
		10%	2.676	3.586
		5%	3.272	4.306
		1%	4.614	5.966

Appendix 5

ARDL Long Run Form, Short Run Form and Bound Test- China

Conditional Error Correction Regression				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LN_GDP_CN(-1)*	-0.11045	0.015465	-7.14155	0
LN_REER_CN(-1)	-0.08933	0.033509	-2.66595	0.0141
LN_BM_CN(-1)	0.205402	0.031155	6.592906	0
LN_GEX_CN(-1)	-0.8676	0.19456	-4.45929	0.0002
D(LN_REER_CN)	0.003812	0.082229	0.046356	0.9634
D(LN_REER_CN(-1))	0.085428	0.074429	1.147767	0.2634
D(LN_REER_CN(-2))	0.147389	0.074289	1.983999	0.0599
D(LN_BM_CN)	1.197053	0.351075	3.409682	0.0025
D(LN_BM_CN(-1))	-1.0055	0.610185	-1.64787	0.1136
D(LN_BM_CN(-2))	1.329998	0.58882	2.258751	0.0342
D(LN_BM_CN(-3))	-1.64012	0.436116	-3.76075	0.0011
D(LN_GEX_CN)	-0.9251	0.254469	-3.63542	0.0015
D(LN_GEX_CN(-1))	0.575346	0.216424	2.658424	0.0144
D(LN_GEX_CN(-2))	0.331687	0.213543	1.55326	0.1346
D(LN_GEX_CN(-3))	0.31237	0.202422	1.543164	0.1371

* p-value incompatible with t-Bounds distribution.

Levels Equation

Case 1 :

No Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_REER_CN	-0.80884	0.26378	-3.06636	0.0057
LN_BM_CN	1.859746	0.117154	15.87433	0
LN_GEX_CN	-7.85539	1.473619	-5.33068	0

EC = LN_GDP_CN – (-0.8088*LN_REER_CN + 1.8597*LN_BM_CN – 7.8554*LN_GEX_CN

F-Bounds Test	**Null Hypothesis : No Levels Relationship**			
Test Statistic	**Value**	**Signif.**	**I(0)**	**I(1)**
		Asymptotic : n = 1000		
F-statistic	13.26529	10%	2.01	3.1
K	3	5%	2.45	3.63
		2.50%	2.87	4.16
		1%	3.42	4.84
Actual Sample Size	37	Finite Sample : n = 40		
		10%	-1	-1
		5%	-1	-1
		1%	-1	-1
		Finite Sample : n = 35		
		10%	-1	-1
		5%	-1	-1
		1%	-1	-1
t-Bounds Test	**Null Hypothesis : No Levels Relationship**			
Test Statistic	**Value**	**Signif.**	**I(0)**	**I(1)**
t-statistic	-7.14155	10%	-1.62	-3
		5%	-1.95	-3.33
		2.50%	-2.24	-3.64
		1%	-2.58	-3.97

Appendix 6

Error Correction Form

Table A6.1

ARDL Error Correction Regression: Japan

ECM Regression Case 2 : Restricted Constant and No Trend				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(LN_GDP_JP(-1))	0.127806	0.156826	0.814954	0.4222
D(LN_GDP_JP(-2))	0.276117	0.152634	1.809007	0.0816
D(LN_GDP_JP(-3))	0.288576	0.146733	1.966677	0.0596
D(LN_BM_JP)	-2.001289	0.540623	-3.701822	0.001
D(LN_GEX_JP)	-1.435945	0.482495	-2.976082	0.0061
CointEq(-1)*	-0.170196	0.04281	-3.975579	0.0005
R-squared	0.512808	Mean dependent var		0.031989
Adjusted R-squared	0.434228	S.D. dependent var		0.046833
S.E. of Regression	0.035227	Akaike info criterion		-3.70661
Sum squared resid	0.038469	Schwarz criterion		-3.44538
Log likelihood	74.57232	Hannan-Quinn criter.		-3.61452
Durbin-Watson stat	2.230538			

* p-value incompatible with t-Bounds distribution.

Table A6.2

ARDL Error Correction Regression: Korea

ECM Regression Case 2 : Restricted Constant and No Trend				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(LN_GDP_KR(-1))	0.535602	0.087779	6.101739	0.0001
D(LN_GDP_KR(-2))	-0.11607	0.082642	-1.40442	0.1855
D(LN_REER_KR)	0.089548	0.100454	0.891429	0.3902
D(LN_BM_KR)	0.846128	0.351046	2.410303	0.0329
D(LN_BM_KR(-1))	-0.07888	0.399141	-0.197632	0.8466
D(LN_BM_KR(-2))	2.5622	0.439167	5.834225	0.0001
D(LN_GEX_KR)	0.732739	0.454392	1.612569	0.1328
D(LN_GEX_KR(-1))	-1.0587	0.428113	-2.472944	0.0293
D(LN_GEX_KR(-2))	2.041862	0.449844	4.539045	0.0007
D(LN_GEX_KR(-3))	-2.86935	0.28719	-9.991126	0
CointEq(-1)*	-0.31395	0.04138	-7.58712	0
R-squared	0.942406	Mean dependent var		0.124089
Adjusted R-squared	0.90641	S.D. dependent var		0.114658
S.E. of regression	0.035077	Akaike info criterion		-3.571
Sum squared resid	0.019686	Schwarz criterion		-3.04307
Log likelihood	59.20848	Hannan-Quinn criter.		-3.41402
Durbin-Watson stat	2.506394			

* p-value incompatible with t-Bounds distribution.

Table A6.3

ARDL Error Correction Regression: China

ECM Regression Case 1 : No Constant and No Trend				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(LN_REER_CN)	0.003812	0.064995	0.058647	0.9538
D(LN_REER_CN(-1))	0.085428	0.066949	1.276009	0.2153
D(LN_REER_CN(-2))	0.147389	0.067613	2.179878	0.0403
D(LN_BM_CN)	1.197053	0.303174	3.948404	0.0007
D(LN_BM_CN(-1))	-1.005502	0.540841	-1.85915	0.0764
D(LN_BM_CN(-2))	1.329998	0.545726	2.437116	0.0234
D(LN_BM_CN(-3))	-1.640122	0.34552	-4.74682	0.0001
D(LN_GEX_CN)	-0.925102	0.2175	-4.25334	0.0003
D(LN_GEX_CN(-1))	0.575346	0.183836	3.129672	0.0049
D(LN_GEX_CN(-2))	0.331687	0.194284	1.707233	0.1019
D(LN_GEX_CN(-3))	0.31237	0.174381	1.791307	0.087
CointEq(-1)*	-0.110446	0.014223	-7.7651	0
R-squared	0.886866	Mean dependent var		0.180383
Adjusted R-squared	0.837088	S.D. dependent var		0.072506
S.E. of regression	0.029265	Akaike info criterion		-3.96822
Sum squared resid	0.021411	Schwarz criterion		-3.44576
Log likelihood	85.41213	Hannan-Quinn criter.		-3.78403
Durbin-Watson stat	2.226204			

* p-value incompatible with t-Bounds distribution.

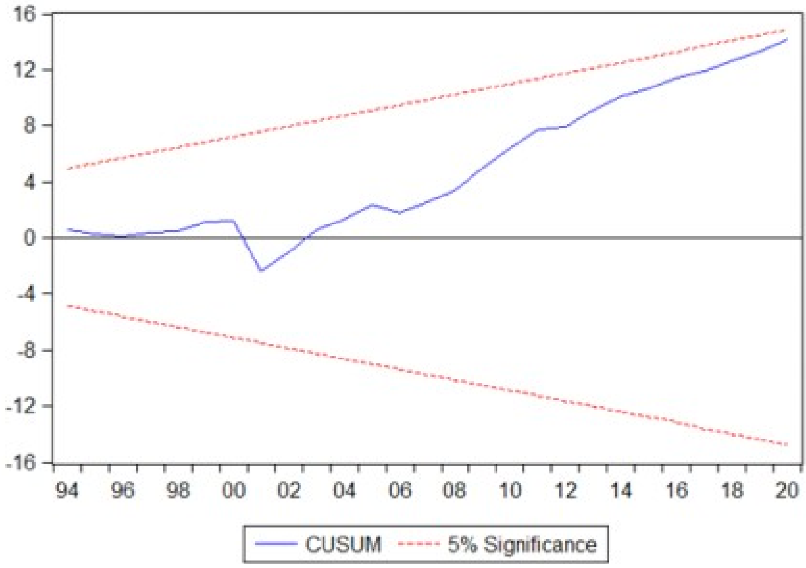
Appendix 7

Variables' Description

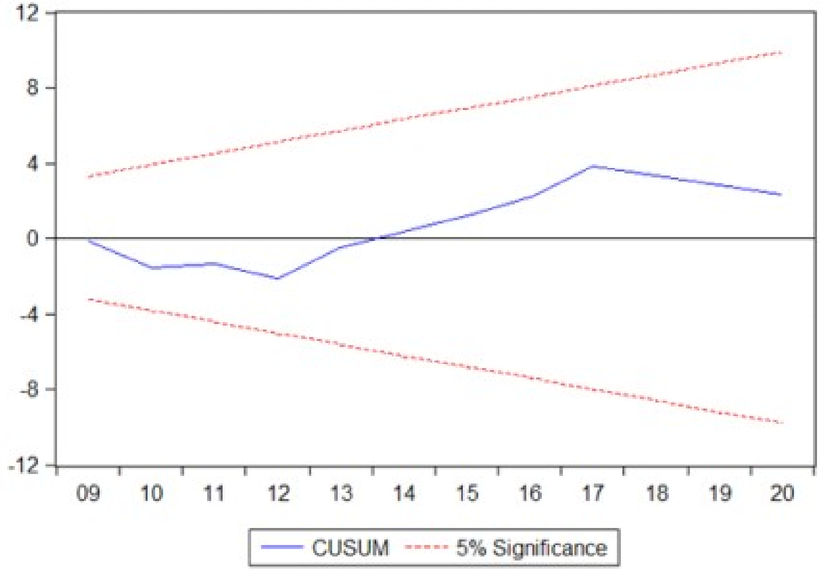
Variable Name	Description
LN_GDP_JP	Natural Log of GDP of Japan
LN_REER_JP	Natural Log of Real Effective Exchange Rate of Japan
LN_BM_JP	Natural Log of Broad Money of Japan
LN_GEX_JP	Natural Log of Government Expenditure of Japan
LN_GDP_KR	Natural Log of GDP of South Korea
LN_REER_KR	Natural Log of Real Effective Exchange Rate of South Korea
LN_BM_KR	Natural Log of Broad Money of South Korea
LN_GEX_KR	Natural Log of Government Expenditure of South Korea
LN_GDP_CN	Natural Log of GDP of China
LN_REER_CN	Natural Log of Real Effective Exchange Rate of China
LN_BM_CN	Natural Log of Broad Money of China
LN_GEX_CN	Natural Log of Government Expenditure of China

Appendix 8

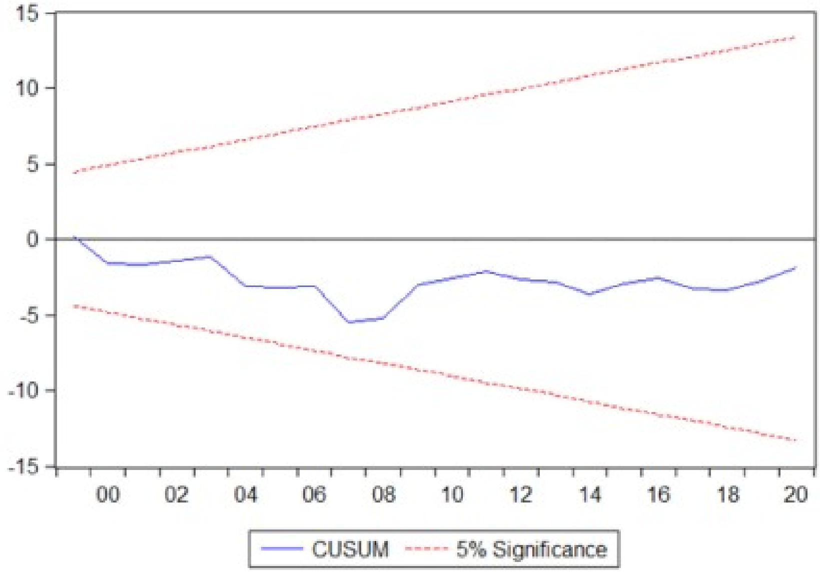
Stability of the Models (CUSUM and CUSUMSQ)



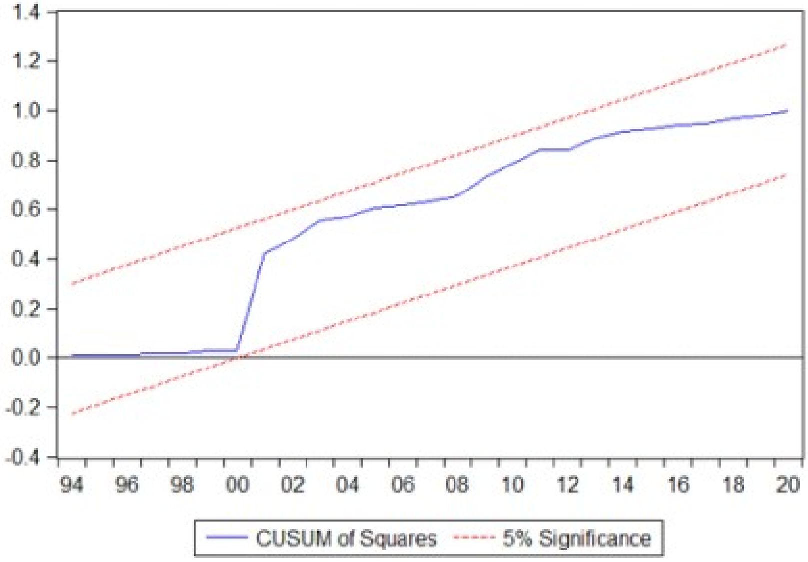
CUSUM : Japan



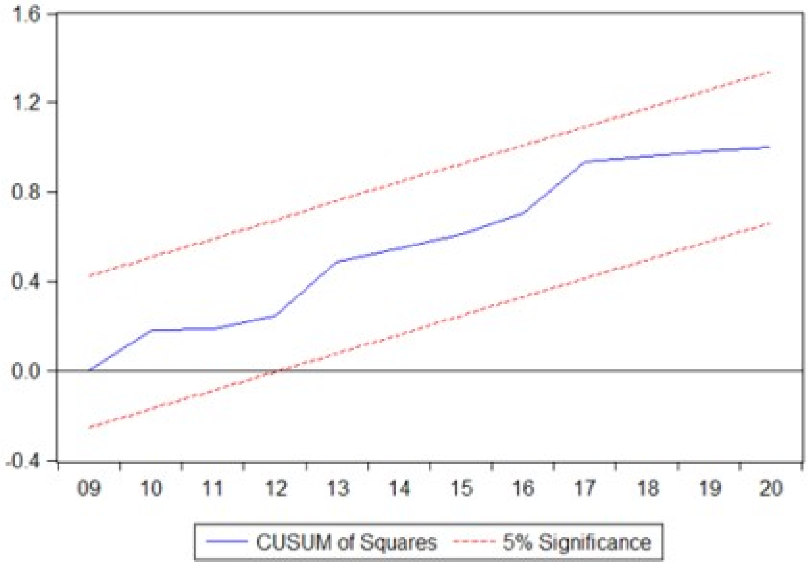
CUSUM : Korea



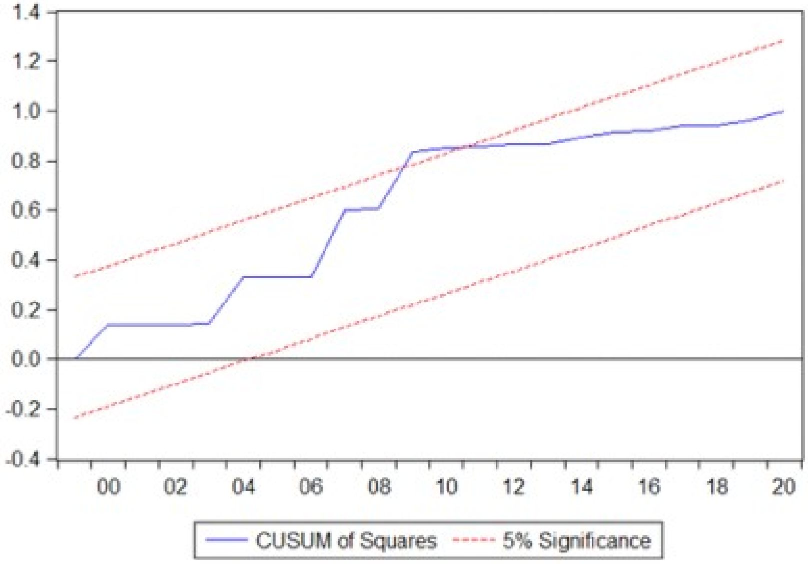
CUSUM : China



CUSUM _Square : Japan



CUSUM _Square : Korea



CUSUM _Square: Korea