Yuan Revaluation and China's External Trade Performance

Fulgence Dominick Waryoba

School of International Education, Capital University of Economics and Business, No.2 Jintaili, Chaoyang District, Beijing, China
Email: fuldominick@yahoo.com

Abstract	*This paper analyzed the effect of Yuan revaluation on China's external trade performance. Using break point unit root analysis, 1994 has revealed to be the beginning of a new regime for real effective exchange rate implying that Yuan peg to US Dollar really played a central role in influencing real effective exchange rate. Though in the short run real effective exchange rate influence on trade seems unimportant, in the long run the influence is positive and economically significant. Since trade involves more than one country, growth in foreign economic activities influences China's exports growth the same way as China's economic growth influences import growth.*
Key words	Exchange rate revaluation, trade performance, economic growth
	JEL Codes: F43, F10, F13

1. Introduction

The Yuan peg to US dollar in 1994 improved China's exports leading into rapid accumulation of foreign currency reserve against US dollar. China's foreign currency reserve grew from USD75.4 billion in 1995 to USD291.1 billion in 2002 leading into a number of warnings by the US including threats to trade sanctions unless Yuan is revalued (Morrison and Labonte, 2008). Finally Yuan appreciation by 2.1 percent materialized in July 2005, with managed floating exchange rate adoption (Goujon and Guerineau, 2006). This was followed by other measures like market-maker system, a more market-based mechanism to determine the daily central parity of Yuan to US dollar exchange rate, wider trading bands against currencies other than US dollar and currency forward and swap contracts to prepare a greater flexibility platform (Shu and Yip, 2006). Yuan peg to a basket of major currencies like Euro, Japanese Yen, Korean Won, and US dollar using a weighted exchange rate namely real effective exchange rate surfaced which somehow settled trade dispute (Isidore, 2005; Catao, 2007; and Salitan, 2010).

China's accession to World Trade Organization (WTO) in 2001 and expiration of multilateral agreement deepened economic significance of export to the economy from 20 percent of GDP in 2000 to 35 percent in 2007. Nevertheless, lower wages made the economy an investment hub of Asia. Economic growth became export oriented and manufacturing investment biased. From 2001 to 2008, export and investment contributed 60 percent to economic growth increasing from 40 percent in 1990s, much larger than the same period's average of the G7, 16 percent, Euro area 30 percent, and the rest of Asia 35 percent (Guo and N'Diaye, 2009; Berger and Martin, 2011; Yao, 2010). The WTO accession had a profound effect on trade stretching China's global market share from 3.3 percent in 2001 to 5.9 percent in 2004 for import and 3.9 percent in 2001 to 6.5 percent in 2004 for export (Lawrence 2006). The single variable unit root analysis with break point adopted in this study provides a useful guide to stress on economic significance of different time periods.

2. Literature Review

Currency devaluation is considered by many economists as a primary determinant of trade balance improvement. Devaluation reduces price level of exports and increases price level of import which directly affects trade balance positively (Stockman, 1980; Appleyard and Field, 1986). Due to this, some governments attempt to devalue their currency through expansionary monetary policy whose effectiveness depends on price flexibility (Bhandari, 1983). However, the success of currency devaluation on trade balance for most countries has not been immediately realized. As initially the economy realizes deteriorating trade balance but later improvements in trade balance materialize. One of the classical explanations for this *J* path phenomenon is the fact that price effects are immediately harming the economy before being outweighed by volume effect (Arndt and Dorrance, 1987).

Economists have also hypothesized that the Marshall-Lerner condition necessitates trade balance improvement with devaluation (see for example Shea, 1979). Shea propose that with Marshall-Lerner condition, devaluation improves trade balance even if part of import consists of intermediate goods. Reinhart has acknowledged by asserting that the developing countries' case is different due to the nature of commodities they export (Reinhart, 1995). But international trades are often

with contracts where for imports they are written in foreign currency and for exports in local currency. These contracts pointed out to be one of factors behind *J* path phenomenon of trade balance (Arndt and Dorrance, 1987), hinder the ability of Marshall-Lerner condition.

The presence of *J* curve has attracted economists' attention for example Backus *et al.* (1994) analyzed the dynamics of trade balance and terms of trade to see whether J-curve exists. The fact that trade balance is affected negatively by current and future terms of trade while positively by previous terms of trade indicates that relative imprice of import and exports are immediately affected by devaluation while the volume of exports and imports effect come latter conforming the *J*-curve path. Carter and Pick's (1989) analysis on how devaluation affected American agricultural trade balance reveals initial deterioration confirming the first segment of the *J* curve as downward sloping.

It is contend that economies select exchange rate regimes based on the goals to be achieved and that those with frequent economic shocks perform better under floating exchange rate regime. In cases where high inflation is a problem, fixed exchange rate is the best option, while floating exchange rate works better to achieve central bank independency or money growth goal (Rose, 2011). However, even flexible exchange rate regime cannot lead into monetary autonomy without capital control for emerging economies when developed economies undertake monetary expansion policies (Han and Wei, 2016). As a result we see many countries have worked under fixed exchange rate regime even without high inflation problem. It is easy to conclude that most economies are scared of the first portion of *J* curve as the time for upward movement of trade balance is unclear and the intensity of negative impact of terms of trade is unknown. The black pit is known to be deep but the depth is unknown.

Devaluation though has been acknowledged to improve trade balance under Marshall-Lerner condition even when part of import is used as intermediate (Shea, 1979). Previously export value used to be almost 100 percent domestic, but nowadays goods pass different borders before they can be exported as final products. In other words raw materials exported to one country to be processed into semifinal goods which are exported to another country to be assembled or processed as final goods before they can be exported for final use in another country (Johnson, 2014). The fact that devaluation makes imports expensive increases the fear for economies which imports some of their intermediate goods. These economies cannot be favored by devaluation. In such circumstances negative impacts necessitated by unfavorable terms of trade may not be easily outweighed by increased export volume in the future because even export volume decline with increased production cost. An impractical realization of the *J* curve's turning point might explain why some economies adopt fixed exchange rate regime even when there is not high inflation.

For developing economies currency peg or fixed exchange rate with capital control provides domestic financial market protecting wall against external shocks. The financial crisis of the 1990s provided lessons to some economies mostly China that adapting floating exchange rate without enough preparation poses a very high risk to the financial market and economic performance. China is a living example of economies which have paid much attention in the process of financial liberalization. In the process of capital liberalization, China adopted the Shanghai Pilot Free Trade Zone (SPFTZ) at the end of September 2013 as a trial for a new round of Chinese reform and opening up (Yao and Whalley, 2015). With capital liberalization, capital inflow is likely to be strong for emerging economies like what happened in Latin America and Caribbean during the 2007 to 2009 global financial crisis. These emerging economies were not hurt by the crisis and continued to experience strong capital inflow even after the crisis. However, it is pointed out that in such circumstances lending booms followed by banking instability are likely (Powell and Tavella, 2015).

China's model of capital liberalization by pilot trial reflects Britain's circumstance during great depression though in a very different context. According to Patnaik (2014) at that time Britain ran a huge trade deficit with her trade partners such as USA, and other European countries. Britain opened the economy to allow more imports so as to fuel economic activities in other economies and at the same time investing capital in those economies. This led into a huge current account deficit with her trade and investment partners. However, Britain managed to survive as a great capitalist economy in that era due to a huge current account surplus maintained with her colonies mostly Indian sub-continent and Malaya. The colonies were made large exporters to other Britain trade parters. Consequently, the surplus and export earnings from those colonies were trivially used by Britain to balance the current account and smoothen the running of the economy.

The study hypothesizes that currency devaluation improves trade balance and contends with Jorda and Burguet (1998) that as economic growth spurs the demand for foreign produced goods increases and that high economic growth for the rest of the world leads into increased exports.

3. Methodology of research

3.1. Data

The study utilizes World Bank's (2016) national accounts data from 1980 to 2015 due to unavailability of China's real effective exchange rate (REER) data beyond 1980. Trade balance is taken as export to import ratio to avoid applying logarithm to negative values. China's GDP is used as a proxy variable for domestic economic activities and sum of GDP for United States (US) and European Union (EU), expressed as WGDP, is taken as a proxy variable for foreign economic activities. According to WTO (2015), these economies had higher world market share in 2014. As their economic activities expand, their domestic demands expand thereby importing more from China. Contrary, as China's economic activities expand, China's imports also grow.

3.2. Model

$$log(TB_t) = \beta_0 + \beta_1 log(REER_t) + \beta_2 log(GDP_t) + \beta_3 log(wGDP_t) + u_t \tag{1}$$

Where; β_i measures the response of trade balance to the ith variable, u_t is the error term which is assumed to be independently and identically distributed, and the other variables are as explained in the data explanation section.

The tendency of non-stationary for time series data confirmed in many studies including Durlauf and Phillips (1988) prevents the use of standard approach in estimating equation (1). If the series are non-stationary, the mean, and variance are not constant, and the error term is serially correlated (Jorda and Burguet, 1998). However, in terms of changes or rates of returns, these derived series appear closer to being stationary (Granger, 2004).

Unit Root Test with a Breakpoint

Structural breaks hinder conventional unit root tests applicability as they are biased toward a false unit root null when the data are trend stationary with a structural break (Perron, 1989). In this study innovative outlier (IO) model is preferred to additive outlier (AO). IO assumes that the break occurs gradually, with the breaks following the same dynamic path as the innovation, while AO assumes the breaks occur immediately. Three break variables applied are: An intercept break variable, $DU_t(T_b) = 1(t > T_b)$ which is 0 for all dates prior to the break, and 1 thereafter; A trend break variable, $DU_t(T_b) = 1(t > T_b)(t - T_b + 1)$ which is 0 for all dates prior to the break, and is a break date re-based trend for all subsequent dates; A one-time break dummy variable, $D_t(T_b) = 1(t = T_b)$ which is 1 only for the break date and 0 otherwise. A difference stationary model is considered as a general null hypothesis:

$$y_t = y_{t-1} + \beta + \psi(L)(\theta D_t(T_b) + \gamma DU_t(T_b) + \epsilon_t) \tag{2}$$

Where ϵ_t are independently and identically distributed innovations, $\psi(L)$ is a lag polynomial representing the dynamics of the stationary and invertible ARMA error process. Here the break variables enter the model with the same dynamics as the innovations. For our alternative hypothesis, we assume a trend stationary model with breaks in the intercept and trend:

$$y_t = \mu + \beta t + \psi(L)(\theta DU_t(T_b) + \gamma DT_t(T_b) + \epsilon_t) \tag{3}$$

The breaks follow the innovation dynamics as in Equation (2). The general Dickey-Fuller test equation, that nests the two hypotheses, is constructed by combining equations (2) and (3) above resulting into the following equation.

$$y_t = \mu + \beta t + \theta DU_t(T_b) + \gamma DT_t(T_b) + \omega D_t(T_b) + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + u_t \tag{4}$$

The null hypothesis, $\hat{\alpha} = 1$, of a unit root is rejected if the t-statistic is greater than the critical value, in absolute term, and *k* lagged differences of the *y* are included to eliminate possible autocorrelation. A variant of models is obtained by placing zero restrictions on one or more of the trend and break parameters $\beta, \theta, \gamma, \omega$. The null and alternative hypothesis explanation tells the structure of the model. A model that assumes non-trending data with intercept break, takes $\beta = \gamma = 0$ which yield tests of a random walk against a stationary model with intercept break. The case of trending data with intercept break, which considers $\gamma = 0$ tests a random walk with drift against a trend stationary model with intercept break. But if the assumption is trending data with intercept and trend break, that is equation (4) without any zero restriction, it is a test for random walk with a drift against a trend stationary with intercept and trend break alternative. The case of trending data with trend break $\theta = \omega = 0$ tests a random walk with drift null against a trend stationary with trend break alternative. Therefore, there are 4 chronologically arranged models in accordance with the explanation.

Co-integration Test

After testing for unit root, the order of integration is established. If the variables are integrated of the same order, they can be co-integrated that is have a long run relationship. Therefore, a test for co-integration must be carried out and in this study Johansen Co-integration test approach is preferred because it is acknowledged to be a powerful tool (see Turner 2009). In this case, the study estimates the following general vector auto regression (VAR) model.

$$y_t = \sum_{i=1}^{p} A_i \, y_{t-i} + B x_t + \epsilon_t \tag{5}$$

Where, y_t is a k-vector of $I(1)$ variables, x_t is a d-vector of deterministic variables, and ϵ_t is a vector of innovations. This can be rewritten as

$$\Delta y_t = \left(\sum_{i=1}^{p} A_i - I\right) y_{t-1} + \sum_{i=1}^{p-1} \left(-\sum_{j=i+1}^{p} A_j\right)_i \Delta y_{t-i} + B x_t + \epsilon_t \tag{6}$$

Or

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + B x_t + \epsilon_t$$

Where Π is the coefficient matrix, which according to Granger's representation theorem, if it has reduced rank $r < k$, then there exist $k \times r$ matrices α and β each with rank r (number of co-integrating relations) such that $\Pi = \alpha \beta'$ and $\beta' y_t$ is $I(0)$. Elements of α are adjustment parameters in vector error correction model. In this test, some of the series are trend stationary, and the assumption that level data y_t and the co-integrating equations have linear trends holds. So we estimate the model:

$$H(r): \Pi y_{t-1} + B x_t = \alpha\left(\beta' y_{t-1} + \rho_0 + \rho_1 t\right) + \alpha_\perp \gamma_0 \tag{7}$$

The terms associated with $\alpha_\perp$ are the deterministic terms outside the co-integrating relations. The analysis provides evidence of co-integrating equations which can be presented as VEC model.

Vector Error Correction (VEC) Model

The Johansen estimation method is based on the error correction representation of the general vector auto regression. Thus, equation (7) for trade balance can be rewritten as an ECM of the form

$$\Delta TB_t = \alpha_0 + \alpha_1 \Delta TB_{t-1} + \alpha_2 \Delta REER_{t-1} + \alpha_3 \Delta GDP_{t-1} + \alpha_4 \Delta WGDP_{t-1} + \lambda(EC_{t-1}) + \varepsilon_t \tag{8}$$

$$EC_{t-1} = TB_{t-1} - \beta_0 - \beta_1 REER_{t-1} - \beta_2 GDP_{t-1} - \beta_3 WGDP_{t-1} - \beta_4 Trend \tag{9}$$

Where α's in (8) stands for short-run coefficients, λ is the speed of adjustment, and β's in the error correction (EC_{t-1}) equation (9), stands for long run equilibrium coefficients.

4. Findings and Discussions

4.1. Unit Root Test

All variables are integrated of order one $I(1)$ as in column 7 of Table 1. Foreign income (WGDP) passes model 1 (a), the data is stationary with intercept break because in Model 3, the break dummy is statistically insignificant, and in Model 4, the lagged WGDP coefficient is statistically not different from zero. Trade balance (TB) does not fit in model 1 (a) because the one-time break dummy is statistically insignificant at 5 percent level. Nevertheless, TB passes all the models, but qualifies only in Model 4, that is trend stationary with trend break because the one-time break dummy variable in Model 1, 2, and together with intercept break in Model 3, are statistically insignificant at 5 percent. The real effective exchange rate (REER) is differenced stationary and therefore fits Model 1 (b). GDP fits in Model 4 only, because the break dummy in Model 3 is statistically insignificant at 5 percent.

From Table 2, each equation is well explained by the explanatory variables except for the differenced REER. The adjusted R-squared indicate a large portion of variation is explained, 80 percent for TB, 29 percent for REER, and almost 100 percent for GDP and WGDP. Large F-statistics indicate the variables are jointly significant. The automatic selection of lag number leads into unique number of lags for each equation with WGDP applying the maximum number of lags. The significance of break variables indicates model appropriateness.

Table 1. Unit Root Test Results

ADF statistics Variable	Model 1		Model 2	Model 3	Model 4	I(d)
TB	-4.92(4)		-5.12(4)	-7.77(4)	-8.09(4)	I(1)
REER	-3.55(4)	-5.38(0)	-2.20(4)	-3.13(0)	-3.31(0)	I(1)
GDP	-1.09(1)		-3.75(6)	-5.79(6)	-5.71(6)	I(1)
WGDP	-6.55(9)		-1.86(9)	-5.55(9)	-5.35(9)	I(1)
Critical Values (5%)	-4.44	-4.44	-4.86	-5.18	-4.53	

Note: Numbers in parentheses against ADF statistics are the lags used in ADF to make them stationary.

China's 2001 decision to join WTO affected economic growth through increased import and export share to the global market. The increased economic activities (GDP) influenced growth in import. China's export also improved from 2001 due to economic growth of the trade partners. Therefore, 2001 is not only the beginning of a new regime for China but also for EU and US. Both import and export were on the rise with slight differences leaving trade balance unaffected by China's accession to WTO.

Trade balance was affected by the 1997 Asian financial crisis. Although Wang (2009) argues that the impact of 1997/98 Asian financial crisis was not so intense to China's economy due to currency peg as other Asian economies devalued their currencies. But since other Asian countries were seriously hit by financial crisis, China's trade must have been affected too making 1998 the beginning of a new regime for trade balance which contends with Waryoba's (2017) findings. Waryoba's analysis on the effect of the 1997 Asian financial crisis on China's productivity growth reveals that China experienced higher productivity growth in years after 1997 than in years before 1997.

Yuan peg to U.S. dollar since 1994 till 2005 where, currency devaluation of about 2 percent was not sufficient to affect real effective exchange rate makes 1994 the beginning of a new regime for real effective exchange rate.

Table 2. Single Variable Analysis

Coefficients	TB	REER	GDP	WGDP
μ	-0.26*** (0.046)	-0.07*** (.032)	5.10*** (0.883)	2.47*** (0.379)
α	-0.89*** (0.234)		0.04 (0.168)	0.75*** (0.039)
θ		0.10*** (0.040)		0.17*** (0.029)
ω		-0.28*** (.099)		-0.16*** (0.045)
β	0.05*** (0.006)		0.09*** (0.015)	
γ	0.05*** (0.007)		0.05*** (0.010)	
c_1	1.16***(0.179)	0.09 (0.170)	0.83*** (0.135)	-0.33* (0.170)
c_2	0.59***(0.170)		0.25 (0.195)	-0.09 (0.158)
c_3	0.47***(0.124)		0.69*** (0.152)	0.39** (0.151)
c_4	0.51***(0.122)		0.43** (0.206)	0.24 (0.138)
c_5			0.35** (0.146)	-0.15 (0.127)
c_6			0.51*** (0.164)	0.09 (0.128)
c_7				-0.53*** (0.151)
c_8				-0.07 (0.196)
c_9				0.74*** (0.176)
T_b	1998	1994	2001	2001
Adjusted R-Squared	0.80	0.29	0.9988	0.993
F-Statistics	18.20	5.51	2597	293
Adjusted Observation	31	34	29	26

Note: ***, **, and * indicate significance at 1, 5, and 10 percent levels. Standard errors are given in parentheses.

4.2. A Test for Co-integration

Where Trace Statistics and Maximum Eigen value, in Table 3, exceed critical values, we reject the null hypothesis of no co-integrating equation at 5 percent. There are two co-integrating equations including trade balance.

Table 3. Johansen Co-integration Tests (1980-2015)

Hypothesized No. of CE(s)	Trace Statistics	0.05 Critical Value	Max-Eigen Value	0.05 Critical Value
None*	96.10	63.88	46.55	32.12
At most 1*	49.55	42.92	33.09	25.82
At most 2	16.46	25.87	10.18	19.39
At most 3	6.27	12.52	6. 27	12.52

Note: * indicates rejection of null hypothesis at 5 percent level.

Co-integrated variables are analyzed in error correction mechanism as in Table 4. The error correction coefficient of -0.752 indicates that it takes one year to correct for about 75.2 percent of discrepancies and the speed is statistically significant at all levels of significance. The speed of adjustment in this case is significantly very high because it takes only about 1 year and 4 months to settle at equilibrium, that is, correct 100 percent of the disequilibrium. The negative sign conforms for convergence towards equilibrium in the long run.

In the short run all the variables except first lag of differenced trade balance, are statistically insignificant which contends with error correction mechanism literature. Discussing short run dynamics is of no use given their insignificance. However, it adds value to highlight on the first lag of differenced trade balance which appears statistically significant. In a nutshell, other factors held constant, last year's trade balance growth rate of 10 percent contributes to the growth rate of about 4.98 percent for this year's trade balance. In the long run all variables are statistically significant with expected signs. Consequently, the long run portion of error correction mechanism provides as the main stay of the final result discussion.

Real effective exchange rate affects trade balance positively. Upward movements in real effective exchange rate translate into lower export prices and high import prices thereby improving trade balance. Since, in this study, trade balance is taken as the logarithm of export import ratio, an increase in export and a decrease in import imply trade ratio increase. Therefore, ceteris paribus, a 10 percentage increase in real effective exchange rate increases predicted trade balance by about 7.37 percent and the effect is statistically significant at all levels of significance.

Table 4. Long run and Short run Estimates

LONG RUN		SHORT RUN	
Variable	EC_{t-1}	Variable	ΔTB_t
TB_t	-1.0000	EC_{t-1}	-0.752***(0.255)
$REER_{t-1}$	0.737***(0.0996)	ΔTB_{t-1}	0.498***(0.202)
GDP_{t-1}	-0.720***(0.092)	ΔTB_{t-2}	0.231(0.229)
$WGDP_{t-1}$	1.031***(0.2098)	$\Delta REER_{t-1}$	0.269(0.238)
$Trend$	0.047***(0.0157)	$\Delta REER_{t-2}$	0.035(0.204)
$Constant$	9.233	ΔGDP_{t-1}	0.193(0.307)
		ΔGDP_{t-2}	0.547(0.362)
		$\Delta WGDP_{t-1}$	-0.043(0.520)
		$\Delta WGDP_{t-2}$	-0.164(0.510)
		$Constant$	-0.075(0.047)
R^2			0.609
Adjusted R^2			0.457

Note: *** indicates significant at 1 percent levels. Standard errors are in parentheses

An increase in domestic activities necessitates an increase in imports because of insufficient domestic production to satisfy domestic consumption or increased demand for production inputs. As China's GDP increase, its import demand also increase and consequently, as for the case explained above, increasing imports reduces the export import ratio thereby reducing trade balance ratio. Hence, ceteris paribus, an increase in GDP by 10 percent reduces the predicted trade balance by about 7.2 percent and the effect is statistically significant at all levels of significance.

Foreign economic activities improvement calls for foreign import increase implying exports to foreign economies improves with an increase in foreign GDP. As noted above that trade balance is logarithm of export import ratio, any improvement in export implies improvement in trade balance. The long run relationship reveals how important are US and EU economies to China's export growth. As a result it can be concluded that holding other factors fixed, an increase in US and EU GDP by 10 percent increases China's trade balance by about 10.31 percent and the effect is statistically very significant at all levels of significance.

The trend variable included due to the fact that some variables are trend stationary and can capture the effect of technology, positively influence trade balance and its effect is statistically significant at all levels of significance. This implies that with time China's technology has been improving thereby increasing exports. Alternatively, foreign economic activities have seen improvement with time increasing importation of China's products. So it can also be concluded that holding other factors unchanged, an increase in time by 10 points increases trade balance by 0.47 percent.

5. Conclusions

The aim of this study was to find out the relationship between Yuan revaluation and trade performance in China. And from the findings, using real effective exchange rate which is deemed a good measure of exchange rate, currency devaluation positively influenced China's export thereby improving trade balance. However, given the fact that China's economy has been growing, the economy's economic activities have with no doubt improved. This made domestically produced goods insufficient to meet increasing demand. Therefore export growth due to increasing exchange rate has been accompanied by import growth resulting from economic growth. Nevertheless, economic growth in the rest of the world greatly influenced China's export growth the same way as domestic economic growth influenced import growth.

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