

## **Analysis of the competitiveness of the Yuan and its impact on Chinese-American trade balance result: An empirical study for the period (2000-2022)**

Maamar Guerrida<sup>1</sup>, Mohamed Elhassen.Allaoui<sup>2</sup>

1. University Kasdi Merbah Ourgla- Algeria , [Maamar.guerrida@gmail.com](mailto:Maamar.guerrida@gmail.com)
2. University Kasdi Merbah Ourgla- Algeria , [Elhassen.allaoui@gmail.com](mailto:Elhassen.allaoui@gmail.com)

**Received:** 01-03-2024

**Accepted:** 14-08-2024

**Published:** 05-09-2024

### **Abstract**

This research examines how fluctuations in the Real Effective Exchange Rate (REER) of the Yuan (Renminbi) influence the trade balance between China and the United States. Utilizing quarterly time series data from the first quarter of 2000 to the fourth quarter of 2022, we apply an Autoregressive Distributed Lag (ARDL) model, with China's and the United States' GDP as control variables. The results indicate a positive correlation between the Yuan's REER and China's trade surplus with the United States over the study period. Moreover, China's GDP shows a negative relationship with its trade balance, whereas the GDP of the United States is positively associated with China's trade surplus with the U.S.

**Keywords:** Real Effective Exchange Rate, Yuan, Trade Balance, ARDL

**Jel Classification Codes :**C22, F10, F14, F31.

### **1.Introduction:**

The global economic scene after the global financial crisis of 2008 witnessed a great deal of controversy and accusations among financial policymakers around the world regarding the causes and proposed solutions to resolve this crisis. China received a greater share of this criticism, as it was accused of manipulating the currency through the yuan (renminbi), especially by the United States of America as China's largest trading partner, especially after China's impressive economic performance over the past three decades. Measured at market exchange rates, China's GDP amounted to 17.96 trillion US dollars in 2022 (THE WORLD BANK, 2024), more than 70% of the United States' GDP, an increase of more than 17% compared to 2020.

As a result, the relationship between the exchange rate and the trade balance later became the focus of attention of many economic researchers. Based on economic literature, it is believed that this dynamic relationship differs between the short and long term, as it is widely believed that the real decline in the value of the currency leads to To improve the trade balance of the country with the reduction in the long term through the effect of size (Belkacem, 2023, p. 469) where the response of the trade balance to this reduction is known as the J.Curve, especially in the case of countries that depend on export economies and seek to improve their competitiveness with various trading partners. Based on the above, and considering that China is accused of manipulating the currency by setting the value of the yuan below its value, we will try to investigate whether the adjustments made by the Chinese authorities from time to time in the value of the yuan contribute to achieving the surplus

recorded in its trade balance against the United States of America. For this purpose, we will formulate the problem of this study as follows:

Do changes in the real effective exchange rate of the Chinese yuan affect the balance of China's trade balance against the United States of America? In order to answer this main problem, we formulated the following hypothesis:

There is a negative relationship between the effect of changes in the real effective exchange rate of the Chinese yuan on the balance of China's trade balance against the United States of America. This study aims to investigate the competitiveness of the Chinese Yuan through its real actual value by measuring the impact of its changes on China's trade balance against the United States of America during the study period extending from 2000 to 2022. Thus, it attempts to determine the validity of the allegations that China manipulates the currency through the exchange rate policy adopted by the Chinese authorities.

In order to understand and attempt to encompass the various aspects of the subject and answer the problem raised and reach the desired goals, we followed during this study the descriptive analytical approach to enrich the theoretical aspect of the study by presenting the basics related to the competitiveness of foreign currencies, exchange rate forms and the Chinese yuan exchange rate policy. As for the applied aspect, the quantitative approach was used by using the Autoregressive Distributed Lag (ARDL) model to measure the impact of the exchange rate on China's trade balance with the United States of America using the real effective exchange rate index for the base year (2010 = 100), relying on the values of quarterly data for the period from 2000 to 2022 using the statistical program EViews 13.

## 2. Literature review:

There are many previous studies related to the subject of our studies, the most prominent of which are:

➤ **The study (Rawabih, 2019)** aimed to measure the impact of fluctuations in the real exchange rate of the Chinese yuan against the US dollar on China's exports to the United States of America during the period (2000-2016). A simple linear regression model was used using annual data from 2000 to 2016 for both China's exports to the United States of America as a dependent variable and the real exchange rates of the Chinese yuan against the US dollar for the same period as an independent variable. The results showed an inverse relationship between the real exchange rate of the Chinese yuan against the US dollar and China's exports to the United States of America.

➤ **The study (Yuan, 2012)** aimed to measure the impact of the real exchange rate of the Chinese yuan on the bilateral trade balance with the United States of America. We find that this study used the joint integration test and the error correction model by including in the model the Chinese and American economic variables, which are the bilateral trade balance, the real exchange rate of the Chinese yuan, and the gross domestic product, sample data from 2005.Q1 to 2011.Q4, where the main results of the study concluded that the US GDP plays an important role in bilateral trade with China, while both China's GDP and the real exchange rate of the Chinese yuan have a limited impact on China's bilateral trade with the United States.

➤ **The study (Islam, 2022)** attempted to investigate the extent of the impact of the real exchange rate of the yuan against the dollar on the US trade deficit with China by working according to an experimental model enhanced by the globalization variable, through which

long-term estimates were obtained according to the joint integration analysis in addition to the corresponding short-term dynamics, as this study concluded that the long-term equilibrium is confirmed and that the real exchange rate of the yuan against the US dollar plays a strong role, while also emphasizing the strong role of both real income and globalization in the US trade deficit with China.

➤ **The study (Joon, 2008)** aimed to investigate the effects of real exchange rates between the Chinese yuan and the US dollar on trade between the two countries, as the results of this study concluded that a 1% decrease in the value of the renminbi leads to an increase in Chinese exports to the United States by 1.7%, while a 1% decrease in the value of the US dollar increases US exports to China by about 0.4%. □ **The study (Hu, 2012)** found that it investigated the relationship between the real exchange rate of the Chinese yuan and the Sino-American trade data, as this study used the joint integration analysis and the error correction model, using quarterly data between China and the United States of America, where it concluded that the most important factor influencing Sino-American trade is the real GDP of the United States.

➤ **The study (Maryam, 2022)** aimed to test the possibility of the existence of asymmetry in the interactions of the trade balance with exchange rate changes, using quarterly data for Algeria for the period from Q1-1988 to Q4-2019, using the NARDL model, and once the rise was separated from the decline through partial aggregates, and nonlinearity was introduced in the estimation and testing procedure. The standard results showed the symmetric effects of exchange rate changes on the trade balance. While the depreciation of the dinar does not have significant effects on the Algerian trade balance, the rise of the dinar has significantly positive effects on the Algerian trade balance, thus concluding the slow transmission of exchange rate reductions to the Algerian trade balance.

### **1.2 . Positioning of the current study within the existing literature:**

After reviewing a sample of previous studies that dealt with the subject of the impact of exchange rate fluctuations on the balance of trade, we found that our study agrees with those studies in many points and differs in others. In terms of the study model and the tools used, we found that most of the studies are related to our current study in many points, the most important of which is their reliance on the quantitative method represented in the standard study, in addition to the fact that the study of both (Hu, 2012) and (Yuan, 2012) agrees with our study in their reliance on the two controlling variables, which are the gross domestic product of both China and the United States of America.

In terms of difference, we find that our study relied on the main independent variable, which is the real effective exchange rate index of the Chinese yuan, while we find that most of the previous studies that were addressed used the real exchange rate, with the exception of the study (Maryam, 2022), which also relied on the independent variable represented by the real effective exchange rate index. As for the results, most of the studies that we addressed concluded that there is an asymmetric relationship between the exchange rate and the trade balance balance, with the exception of the studies (Maryam, 2022) and (Yuan, 2012), which agree with our study in general on the existence of a symmetric relationship between the exchange rate and the trade balance balance, or in other words, the lack of importance of the exchange rate on the trade balance balance.

## 2. Theoretical framework:

During this axis, we will address the theoretical framework of the currency and its competitiveness, especially with regard to the conflict between foreign currencies, in addition to addressing the most general methods of correcting the imbalance in the balance of payments.

### 2.1. Foreign exchange competitiveness:

Returning to the term foreign exchange competitiveness, we find ourselves talking about two concepts of competitiveness:

**The first concept** is related to the competitive devaluation of the currency (currency war), and its goal is to gain greater competitiveness for the devaluation country. According to economic literature, currency devaluation is one of the classical approaches adopted in adjusting the balance of payments during an imbalance, which depends on the elasticities of demand for the country's exports and imports (Belkacem, 2023, pp. 462-463). Historically, competitive devaluation has been used more than once during the past century and was highlighted again after the global financial crisis in 2008, when China and some countries were accused of manipulating the currency in order to gain competitiveness for their exports through competitive devaluation. This phenomenon was later called currency war; and it is the subject of our study.

**The second concept** relates to competitive currency appreciation (reverse currency war) (Frankel, 2022), which means resorting to currency appreciation or seeking to strengthen the currency's position against various international currencies, whether intentionally or unintentionally, similar to what the United States of America is doing through its monetary policy through the Federal Reserve's upward interest rate path since May 2022 when it rose by 50 percentage points to 1% to reach 5.5% on July 26, 2023, with the aim of confronting high inflation rates, which will inevitably affect attracting capital flows inward and raise the value of the dollar, without forgetting the euro currency after its creation in 1999 when it sought to impose its position against the dollar and other anchor currencies.

### 2.2. Criteria for currency manipulation in the United States of America:

The United States applied three criteria to describe any country with a trade surplus, which are: (Yu, 2020, pp. 253-254):

- a). The current account surplus ratio compared to GDP is higher than 3% for several consecutive years;
- b). The country's central bank must intervene in the foreign exchange market to reduce the value of its currency against the US dollar during the previous six months;
- c). The country must achieve a positive current account surplus of more than \$20 billion for several years.

### 2.3 Yuan exchange rate policy:

The Chinese authorities have implemented multiple policies for the Chinese Yuan since its inception in 1948. We will stop at the most important of them:

**-The first stage(1994 to 2004):** During this period, a fixed parity policy was implemented against the dollar, where 1 dollar was set to equal 8.3 yuan. It is noteworthy that during the Asian crisis in 1997, the Chinese authorities decided to show regional solidarity with their neighbors who were facing difficulties as a result of the crisis. (Figuière & Guilhot, 2011, p.

4) As for the second to fourth stages, they were as follows: (China Development Research Foundation, 2015, pp. xx-xxxii)

**-The second stage (July 2005 to June 2008):** On the twenty-first of June 2005, the People's Bank of China announced that from that day onwards, it would implement a managed floating exchange rate system, based on market supply and demand, with adjustments to the currency basket. The main goal of the reform was to establish a system that would ensure that the yuan's exchange rate remained basically stable at reasonable and balanced levels. Thus, after this system, the yuan's exchange rate would no longer be pegged solely to the US dollar. Instead, a basket of currencies would be selected that would give an appropriate weight to the listed domestic currency, according to China's actual conditions in external economic relations.

**-The third stage (July 2008 to June 2010):** During 2008, the subprime mortgage crisis in the United States gradually developed into a global financial and economic crisis. During this period, the range in which the yuan was allowed to float was restricted again, and the exchange rate returned to the de facto pegged exchange rate system. The range in which the yuan was allowed to fluctuate was restricted, with the yuan trading between 6.82 and 6.84 per dollar, which was an effective return to the currency peg against the dollar.

**-The fourth stage (2010-2014):** In June 2010, with the global economic recovery continuing and international expectations regarding the RMB exchange rate beginning to stabilize, and with the imbalance in international payments in China declining to some extent, it became possible to resume reform of China's exchange rate formation mechanisms again, as the value of the yuan generally increased with the reforms.

**-The fifth stage (from 2015 to the present):** Starting from August 11, 2015, the People's Bank of China announced the central parity rate of the yuan against the US dollar, which will be determined every morning, taking into account the previous day's closing price, market demand and supply, and other currency valuations. The yuan witnessed a 3% decrease in its value against the US dollar, followed by the internationalization of the Chinese currency, the yuan, during its inclusion in the Special Drawing Rights basket by the International Monetary Fund starting from October 1, 2016. In addition, many events affected the yuan's exchange rate policy during this period, most notably the increasing tensions with the United States of America since 2018, so that the yuan continues to fluctuate between 6.45 and 6.91 to the dollar to this day.

**2.4 The most important forms of the exchange rate:** The exchange rate has several forms. We will briefly discuss the most important of them, which are those approved by international financial organizations and bodies such as the International Monetary Fund and the World Bank Group, as follows:

**2.4.1. Nominal exchange rates (NER):** They are also divided into two types:

**a-The bilateral nominal exchange rate:** It is the price of one currency in relation to another currency and is usually expressed as the local price (Marghith, 2019, p. 24) and announced by the banking system every day and is divided into two parts, official and related to official trade exchanges and parallel used in the markets.

**b-The nominal effective exchange rate (NEER):** It is the average of the bilateral nominal prices between the country and all its trading partners, weighted by the trade shares of each partner and written mathematically as follows:

$$NEER_j = \sum_{i=1}^n \alpha_{ij} \left( \frac{(R_{ij})_t}{(R_{ij})_{t_0}} \times 100 \right) \quad (1)$$

Where  $NEER_j$  is the effective nominal exchange rate of the country (j),

$(R_{ij})$  is the The nominal binary, t and  $t_0$  are respectively the measurement period and the base period, n represents the number of trading partners. (Marghith, 2019, p. 25)

#### 2.4.2 Real exchange rates (RER):

Nominal exchange rates are not considered evidence of the development of the currency's value and purchasing power, nor do they allow knowing whether currencies are valued at more or less than their value. Accordingly, we resorted to working with real exchange rates, which are divided into two parts: (Marghith, 2019, pp. 26-30)

**a-The real bilateral exchange rate:** It is the product of the nominal exchange rate and the price ratio between two countries, where it is written as follows:

$$RER_j = R_{ij} \left( \frac{P_i}{P_j} \right) \quad (2)$$

Where:  $P_i$  and  $P_j$  are, respectively, the price levels in the two countries (j) and (i) in the local country and the prices of its trading partners, expressed in a common currency.

**b-Real Effective Exchange Rate (REER):** It is the average of the bilateral real exchange rates between the country and each of its trading partners, weighted by the trade shares of each partner. Mathematically, it is written as follows:

$$REER_j = \sum_{i=1}^n \alpha_{ij} \left[ \frac{\left[ \frac{P_j R_{ij}}{P_i} \right]_t}{\left[ \frac{P_j R_{ij}}{P_i} \right]_{t_0}} \times 100 \right] \quad (3)$$

**Where:**

**P<sub>j</sub>:** is the inflation rate of country j measured by the Consumer Price Index (CPI);

**P<sub>i</sub>:** is the inflation rate of trading partner i measured by the Consumer Price Index (CPI)

**R<sub>ij</sub>:** is the bilateral nominal exchange rate of countries i and j;

**n:** is the number of current partners;

**$\alpha_{ij}$ :** is the trade share of each partner expressed as imports of country (j) from trading partner (i) in the base period ( $t_0$ ), knowing that  $\sum_{i=1}^n \alpha_{ij} = 1$

### 3. Specification of models and methods:

#### 3.1. Study model and variables:

In this part of the study, we will test the impact of changes in the Chinese yuan exchange rate on China's trade balance against the United States of America for the period

from 2000 to 2022, quarterly data, as the data for the study variables were obtained from the website of the International Monetary Fund and the website of the World Bank.

To monitor the relationship between the real effective exchange rate index of the yuan and China's trade balance against the United States of America, we will use the RDL model, which is a linear time series model through which the dependent and independent variables are determined not only simultaneously, but also across historical (lagged) values, as this model was tested using the EViews13 software.

**A.Study model:**

$$BALE = \alpha_0 + \alpha_1 EXCH + \alpha_2 GDP_{China} + \alpha_3 GDP_{us} + \varepsilon$$

**B.Dependent variable:**

➤China's trade balance against the United States of America: We symbolize it with the symbol BAL.

**C.Independent variables:**

- Real effective exchange rate (REER) (and we symbolize it abbreviated as EXCH;
- Gross domestic product of China and we symbolize it with the symbol GDP\_CH;
- Gross domestic product of the United States of America and we symbolize it with the symbol GDP\_US;
- Model parameters:  $\alpha_0, \alpha_1, \alpha_2, \alpha_3$ ;
- Random error:  $\varepsilon$ .

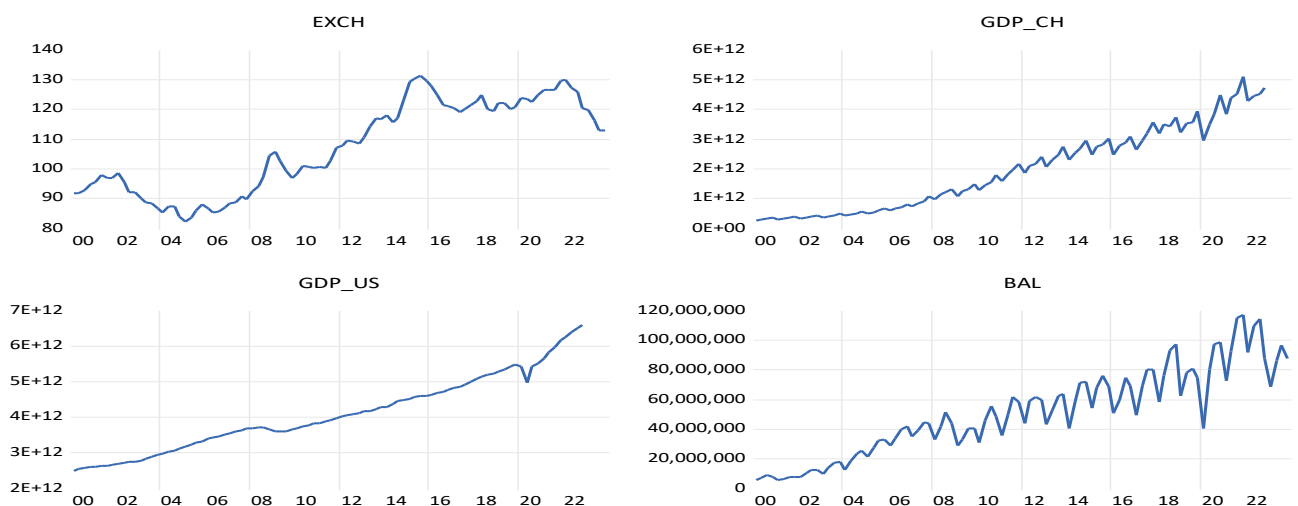
**3.2 Descriptive and graphical analysis of study variables**

Before testing the study hypotheses, we analyze some descriptive statistics and study each variable separately by tracking its developments over time.

**3.2.1 Graphical analysis**

The figures below show the developments of each of The dependent variable is the China-US trade balance BAL measured in US dollars, the explanatory variable is the real effective exchange rate of the Chinese yuan EXCH measured as a purchasing power parity index, and the control variables are China's GDP\_CH and the United States' GDP\_US measured in US dollars. For the period 2000 to 2022 with quarterly frequencies.

**Fig.1: Developments in study variables for the period 2000.Q:1-2022.Q:4**



Source: Prepared by researchers using EViews13

Figure (1) shows that the data of China's trade balance against the United States of America is positively consistent with the real effective exchange rate of the Chinese yuan, which indicates that the increase in the real effective exchange rate contributes to increasing China's trade balance against the United States. In contrast, the gross domestic product of both the United States of America and China shows that they have been continuously increasing since the beginning of the millennium, but they experienced a deterioration in 2020 due to the decline in global demand due to the Corona pandemic (Covid-19) before recovering and growing again.

### 3.2.2 Descriptive analysis

The statistical study of the variables concerned is concerned with describing the arithmetic means and standard deviations for each variable separately and comparing them. The results are shown in Table. 1:

**Table.1: Descriptive statistics for the study variables**

Mean	106.7503	1.97E+12	4.10E+12	49877140
Median	105.1213	1.84E+12	3.90E+12	47566150
Maximum	131.2056	5.10E+12	6.60E+12	1.17E+08
Minimum	82.37256	2.58E+11	2.50E+12	5807960.
Std. Dev.	15.46069	1.38E+12	1.06E+12	28902170
Skewness	0.032003	0.393012	0.442487	0.316110
Kurtosis	1.492088	1.950690	2.398630	2.405693
Jarque-Bera	8.731937	6.589058	4.388497	2.886125
Probability	0.012702	0.037085	0.111442	0.236203
Sum	9821.028	1.81E+14	3.77E+14	4.59E+09
Sum Sq. Dev.	21751.98	1.73E+26	1.01E+26	7.60E+16
Observations	92	92	92	92

**Source: Student calculations using EViews13**

From the statistics shown in Table.1, we generally notice that the averages of the variables reflect the data shown in Figure. 01 above.

In order to study the linear relationship between the dependent variable and the independent variables, it is necessary to first verify the existence of a relationship between the variables by analyzing Pearson correlation coefficients.

**Table.2: the correlations between the dependent variable and the independent variables**

Correlation				
Probability	EXCH	GDP_CH	GDP_US	BAL
EXCH	1.000000			
GDP_CH	0.913613	1.000000		
GDP_US	0.862752	0.976530	1.000000	
BAL	0.811989	0.948591	0.937878	1.000000

**Source: Prepared by researchers using EViews13**

It is clear from Table.2, that all independent variables have positive correlations with the dependent variable. We notice a strong and statistically significant direct relationship at a significance level of 1% between the independent variable EXCH and the dependent variable BAL, with a correlation degree reaching 81%. Also, there is a very strong and statistically

significant direct relationship at a significance level of 1% between the control variables and the dependent variable EXCH, with a correlation degree exceeding 90%.

**4. Empirical study:** After describing the variables and verifying the initial hypotheses, and before determining the appropriate model, we take the first steps of the applied study, which is to study the stability of the variables under study.

**4.1. Time series stability tests**

The stage of analyzing and studying the stability of the time series under study is an initial and basic stage in order to know the nature of the changes that occur in their values in different times periods. In addition, it enables us to determine the method of dealing with the components of the variables in order to determine the appropriate model for measuring the relationships of influence between them.

There are three famous tests: ADF (Advanced Dickey-Fuller), PP (Phillips-Perron) and KPSS (Kwiatkowski, Phillips, Schmidt, and Shin), but they lose their effectiveness in small samples or in the case of a difference in the variance of stability models errors except for the PP test because it is an effective non-parametric test regardless of the standard problems, so we will rely on the PP test in our study.

The PP test methodology is based on estimating three (03) statistical models: Intercept, Trend and intercept, None. Each model is an autoregressive with lag degrees determined according to the information criteria (AIC, BIC, HQ). To conduct this test, we estimate the model coefficients using the ordinary least squares (OLS) method and test the statistical significance of the dynamic variable using the tau statistic according to the following two test hypotheses:

$H_0: \lambda = 0 \Rightarrow \phi = 1$  Presence of a unitary root

$H_1: \lambda \neq 0 \Rightarrow \phi \neq 1$  No unitary root

We address the estimation process directly, and the test results are summarized in Table

**Table.3: Stability tests for study variables using Phillips-Perron**

Variables	Models	The probability value of the tau statistic		Decision
		After the first difference	At the level	
BAL	Trend and intercept	0.0001	0.0001	I(1)
	intercept	0.0001	0.2298	
	noTrend and nointercept	0.0001	/	
EXCH	Trend and intercept	0.0001	0.8611	I(1)
	intercept	0.0001	0.6889	
	no Trend and no intercept	0.0001	/	
GDP_CH	Trend and intercept	0.0001	0.0001	I(1)
	intercept	0.0001	0.9948	
	no Trend and no intercept	0.0001	/	
GDP_US	Trend and intercept	0.0001	0.9988	I(1)
	intercept	0.0001	0.9999	
	no Trend and no intercept	0.0001	/	

**Source: Prepared by researchers using EViews13**

By reading the latter, it becomes clear that the probability value of the t-statistic in the categorical model for all four variables is greater than the significance level of 5%, and thus

the null hypothesis is accepted, which states that the variables contain a unitary root, i.e. they are not stable at their original level, and this is without the need to discuss the results of the rest of the statistical models. However, it is noted that all the variables stabilized after the first difference in the three statistical models since the probability values are all less than 1%, and therefore they are integrated of the first degree I1

As a result, and according to the methodology of standard studies, if there are variables at the same degree of integration, we can adopt the methodology of testing the limits and the model of autoregressive distributed lags ARDL.

#### 4.2 Estimating the ARDL model

In this step, we seek to estimate the applied study model using the ordinary least squares (OLS) method according to the methodology of testing the limits and the ARDL model, where the equation resulting from this methodology shows the functional relationship that links the dependent variable BAL, with the explanatory variable EXCH and the control variables GDP\_CH, GDP\_US.

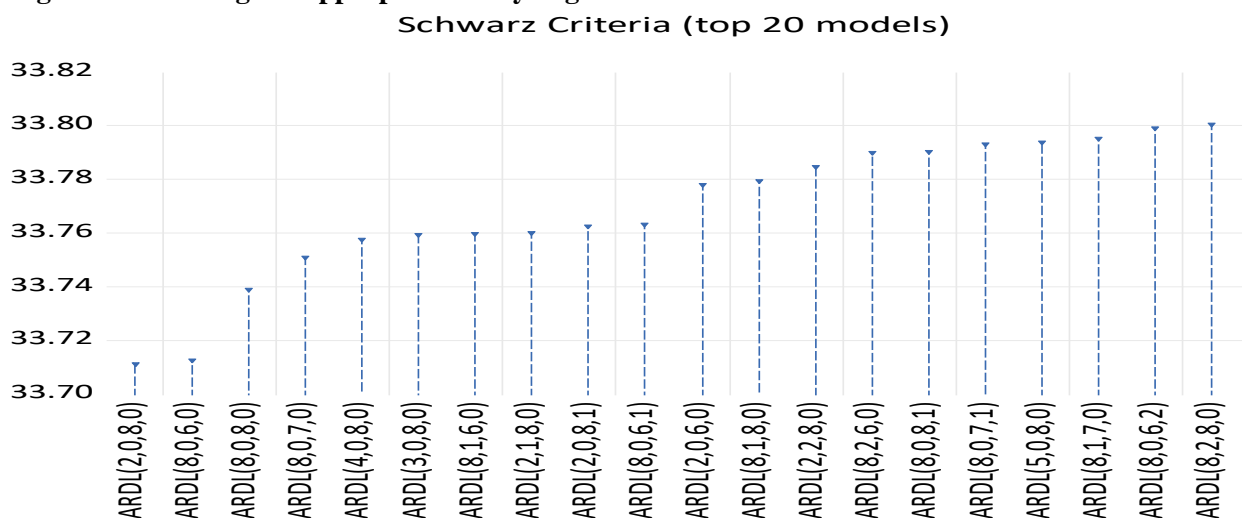
The functional relationship includes long-term coefficients, short-term coefficients, and error correction coefficient. The literature assumes that the independent variable EXCH has a positive effect on the dependent variable BAL between China and the United States for the period 2000:1-2022:4.

##### 4.2.1. Specifying the appropriate lags:

In order to choose the appropriate statistical model to estimate the ARDL model that gives us the best results that measure the relationships between the variables of our study, we choose between 8 lags (i.e. two years) for each variable according to the basic information criterion (BIC) to choose the optimal lag degrees.

The results are shown in Figure (02), which show that the appropriate model for the data and variables of our study is the one that includes a fixed term and a restricted general trend and takes the following distributed lags ARDL(2,0,8,0)

**Figure.2: Choosing the appropriate delay degree for the ARDL model**



Source: Prepared by researchers using EViews13

The results of the model estimation are shown in Table.4, its parameters are formed by the fixed term, the general trend and the coefficients of the following variables:

- Two lags for the dynamic variable BAL.
- The independent variable EXCH without lag.
- 8 lags for the first control variable GDP\_CH.
- 0 lags for the second control variable GDP\_US.

**Table.4: Results of estimation of the ARDL model 2,0,8,0**

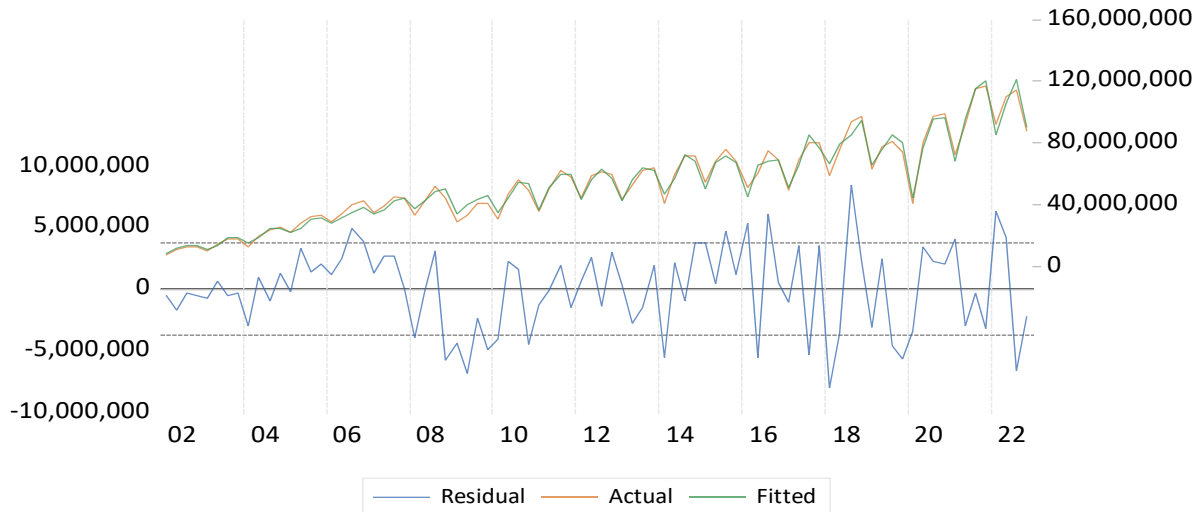
<b>Dependent Variable: BAL</b> <b>Method: ARDL</b> <b>Date: 05/12/24 Time: 06:36</b> <b>Sample: 2002Q1 2022Q4</b> <b>Included observations: 84</b> <b>Dependent lags: 8 (Automatic)</b> <b>Automatic-lag linear regressors (8 max. lags): EXCH GDP_CH GDP_US</b> <b>Deterministics: Unrestricted constant and restricted trend (Case 4)</b> <b>Model selection method: Schwarz criterion (SIC)</b> <b>Number of models evaluated: 5832</b> <b>Selected model: ARDL(2,0,8,0)</b>				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
BAL(-1)	0.570905	0.121256	4.708273	0.0000
BAL(-2)	-0.505660	0.122758	-4.119174	0.0001
EXCH	196754.4	115242.5	1.707308	0.0923
GDP_CH	3.42E-05	4.57E-06	7.488456	0.0000
GDP_CH(-1)	-5.00E-05	6.72E-06	-7.446116	0.0000
GDP_CH(-2)	3.70E-05	8.16E-06	4.529556	0.0000
GDP_CH(-3)	-9.53E-06	7.48E-06	-1.273308	0.2072
GDP_CH(-4)	-2.54E-06	6.04E-06	-0.420911	0.6751
GDP_CH(-5)	1.29E-05	7.13E-06	1.802888	0.0758
GDP_CH(-6)	-3.15E-05	7.21E-06	-4.368247	0.0000
GDP_CH(-7)	2.05E-05	7.61E-06	2.686981	0.0090
GDP_CH(-8)	-2.11E-05	5.94E-06	-3.558019	0.0007
GDP_US	1.81E-05	5.33E-06	3.399741	0.0011
C	-60362545	21825394	-2.765702	0.0073
@TREND	521969.6	153719.0	3.395608	0.0011
R-squared	0.983785	Mean dependent var	4	5393689
Adjusted R-squared	0.980496	S.D. dependent var	9	2690574
S.E. of regression	3757612.	Akaike info criterion		33.27690
Sum squared resid	9.74E+14	Schwarz criterion		33.71097
Log likelihood	-1382.630	Hannan-Quinn criter.		33.45139
F-statistic	299.0313	Durbin-Watson stat		1.943084
Prob(F-statistic)	0.000000			

Source: Prepared by researchers using EViews13

#### 4.2.2.Diagnostic test:

Before analyzing the estimation results, the statistical and standard quality of the model must be verified by examining the residuals that must meet the conditions of the ordinary least squares method.

**Fig.3: the residuals of the ARDL(2,0,8,0) model.**



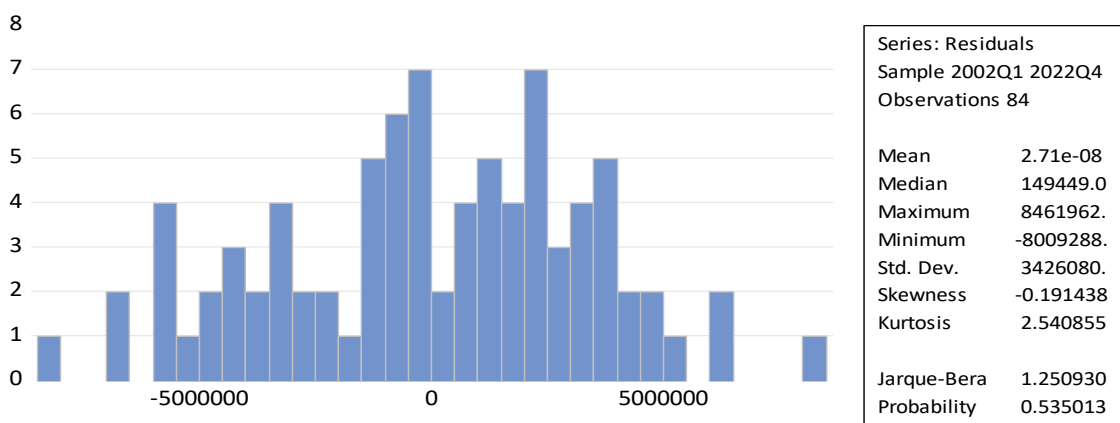
**Source: Prepared by researchers using EViews13**

The figure above shows that the difference between the actual and estimated values representing the residuals move randomly and with relatively constant variance, indicating that the basic conditions of the OLS method are met. To verify this, we present the following tests:

**4.2.2.1 Test of normal distribution of errors**

The Jacques-Pera test determines whether the estimated residuals are normally distributed or not? Accepting the null hypothesis means that the residuals are normally distributed, which is a necessary condition, especially in small samples. We notice in Figure.4 that the probability value of the test statistic is equal to 0.535, which exceeds the significance level of 5%, and thus accepting the null hypothesis that states that the residuals are normally distributed, as confirmed by the bell shape of the error distribution in the figure below.

**Fig.4: the normal distribution test for the ARDL model (2,0,8,0)**



**Source: Prepared by researchers using EViews13**

**4.2.2.2 Residuals Autocorrelation test:**

In order to Residuals Autocorrelation test, we conduct the LM test, which states the null hypothesis of the test statistic that there is no autocorrelation problem between the residuals of the estimate. From Table.5, we see that the probability value of the Chi-square statistic is equal to 0.087, which is greater than 5% of the significance level, and thus there is no autocorrelation problem between errors.

**Table.5. the autocorrelation test for the residuals of the ARDL model (2,0,8,0)**

<b>Breusch-Godfrey Serial Correlation LM Test:</b>			
Null hypothesis: No serial correlation at up to 3 lags			
F-statistic	1.865970	Prob. F(3,66)	0.1439
Obs*R-squared	6.567573	Prob. Chi-Square(3)	0.0870

Source: Prepared by researchers using EViews13

**4.2.2.3 Heteroscedasticity tests:**

The White test checks for the presence of homoscedasticity or heteroscedasticity in the errors, as the null hypothesis states that the hypothesis of stability of error variance is achieved. Table.6 shows that the error variance is homogeneous according to the probability value of the Chi-square statistic, which is equal to 0.065, which is greater than 5% of the significance level, there is no heteroscedasticity problem in the estimation residuals.

**Table.6: White’s test for the stability of the variance of the residuals of the ARDL model (2,0,8,0)**

<b>Heteroskedasticity Test: White</b>			
Null hypothesis: Homoskedasticity			
F-statistic	1.827086	Prob. F(14,69)	0.0517
Obs*R-squared	22.71803	Prob. Chi-Square(14)	0.0650
Scaled explained SS	11.80979	Prob. Chi-Square(14)	0.6216

Source: Prepared by researchers using EViews13

**4.2.3. Heteroscedasticity tests:**

After examining the residuals of the estimate and verifying the availability of the conditions for the validity of the ARDL model, we conduct sensitivity tests that prove the immunity of the model to any possible structural changes, and prove the quality of the description of the statistical model.

**4.2.3.1 Testing the quality of description**

The RESET test decides whether the estimated model is well specified, without adding or deleting important variables within the independent variables, as accepting the null hypothesis indicates that the model is well described, which increases the credibility of relying on the estimation results. We note in Table No. (07) that the probability value of the F- statistic equals 0.0509, which is greater than the significance level of 5%, indicting that the model is accurately specified.

**Table.7: the Ramsey test for the quality of the description of the ARDL(2,0,8,0) model.**

<b>Ramsey RESET Test</b>	
Equation: EQ01	

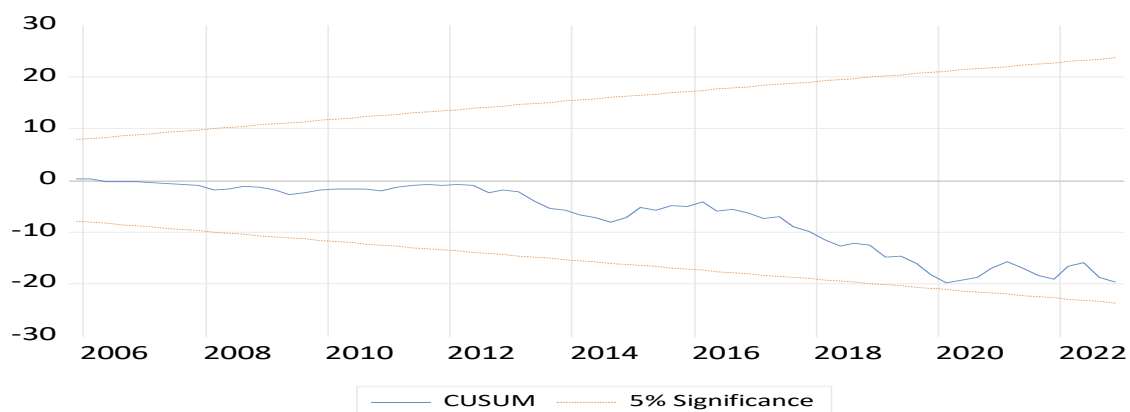
<b>Omitted Variables: Powers of fitted values from 2 to 3</b>			
<b>Specification: BAL BAL(-1) BAL(-2) EXCH GDP_CH GDP_CH(-1)</b>			
<b>GDP_CH(-2) GDP_CH(-3) GDP_CH(-4) GDP_CH(-5) GDP_CH(-6)</b>			
<b>GDP_CH(-7) GDP_CH(-8) GDP_US C @TREND</b>			
	<b>Value</b>	<b>df</b>	<b>Probability</b>
<b>F-statistic</b>	3.113230	(2, 67)	0.0509
<b>Likelihood ratio</b>	7.464593	2	0.0239

Source: Prepared by researchers using EViews13

**4.2.3.1. Parameter Stability Test:**

To assess the stability of the model parameters over the study period, we conduct the CUSUM test. As shown in Figure.5, the blue line representing the cumulative sum of residuals remains within the confidence intervals (red lines). Therefore, the model is stable and the parameters are consistent throughout the study period.

**Figure.5: the stability test of the ARDL(2,0,8,0) model using CUSUM**



Source: Prepared by researchers using EViews13

**5. Results and discussion:**

**5.1 Co-integration Test and long-Run Equation**

Through the equation shown in Appendices 1 and 2 and summarized in Table No. (08), we find that the Fisher statistic for the limit test equals 10.106, which is greater than 4.053, which represents the upper limit for a sample of 80 observations at a significance level of 5%. Therefore, we reject the null hypothesis and move towards accepting the alternative hypothesis, which states that there is a joint integration relationship between the dependent variable BAL and the study variables EXCH, GDP\_CH, GDP\_US, as well to the general trend limit.

**Table.8: the long-term coefficients of the ARDL model (2,0,8,0) and the bounds test.**

Variables	coefficients	Standard deviation	Student statistic	p
General trend	558403.0	147943.3	3.774439	0.0003

EXCH	210487.8	112914.0	1.864143	0.0660
GDP_CH	-1.10E-05	4.00E-06	-2.749578	0.0074
GDP_US	1.94E-05	4.06E-06	4.773645	0.0000
Testing the limits	Fisher's statistic	10.106	Critical values at 5% significance level	
			I(0)	I(1)
			3.235	4.053

Source: Prepared by researchers using EViews13

## 5.2 Error Correction Model and Short-Run Coefficients

Through the equation shown in Appendix 3, we find that the error correction limit parameter is significant at the 5% level with a statistical significance level equal to 0.0001, with the expected negative sign of the parameter with a maximum value of 0.9347, and this result is considered supportive of the existence of a long-term equilibrium relationship between the variables, as it represents the speed of returning to the observed equilibrium position in the long term in the event of an unexpected imbalance or shock, and the return to equilibrium period is about 3 months. That is, when the trade balance deviates from its equilibrium position recorded in the long term in the period  $t-1$ , the equivalent of 93% of this imbalance is corrected in the period  $t$ , until it returns to equilibrium in the following three months.

The results also indicate that the explanatory power of the error correction model is equal to about 0.9347, meaning that the independent variables in the short term explain 93% of the changes in the dependent variable.

## 5.3 Analysis of the results:

### 5.3.1. Statistical Analysis:

Regarding the partial significance of the explanatory variables, all variables are statistically significant at a significance level of 5% except for the REER variable, which has a significance level of 10%. In some detail, an increase in the REER by one unit leads to an increase in China's long-run trade surplus by \$210,487, *ceteris paribus*. This effect is significant given the Student's  $p$ -value of 0.0660.

We also note that an increase in the US GDP by \$1 million leads to an increase in China's long-run trade surplus by \$1.94 million, *ceteris paribus*. This effect is significant given the Student's  $p$ -value of 0.0001.

As for China's GDP variable, it has a negative effect on the trade balance with a marginal increase in the deficit estimated at \$1.10 million for every \$1 million increase. This effect is significant considering the probability value of the Student statistic which is equal to 0.0074.

The general trend that can be interpreted as an external factor affecting the balance of China's trade balance which can include political, economic, social and especially technological factors, as the increase in technological development or demographic growth

leads to an increase in the surplus in the balance of trade balance at an annual rate of 558403 US dollars. This effect is significant at a statistical significance level equal to 0.0003.

### **5.3.2. Economic Analysis of the Results:**

As explained above in the interpretation of the results statistically, the positive relationship between the real effective exchange rate of the Chinese yuan and its trade balance against the United States of America was observed. This positive relationship is explained especially in light of the failure to achieve the "Marshall-Lerner" condition, which states that to improve the trade balance as a result of exchange rate changes, the sum of the elasticities of demand for exports and imports must be greater than one. It also indicates that the appreciation of the currency must lead to a deterioration in the trade balance in the case of traditional demand elasticities, as this can be attributed to a set of reasons that we summarize as follows:

-Improvement in the quality of Chinese products, which may improve in terms of quality and technology, as the demand for these products may increase regardless of the exchange rate of the yuan. In this case, the appreciation of the yuan can lead to an increase in trade revenues resulting from exports, in addition to the trade and investment policies that Encourage investment in export industries or provide incentives to exporters, which allows exports to increase even with the appreciation of the yuan;

-The impact of exchange rate changes on the trade balance may not be immediate, as it may take time for businesses and consumers to adjust to the new prices. Therefore, the positive relationship may appear temporarily before the expected effect of the Marshall-Lerner condition appears;

In addition to the reasons mentioned above, geopolitical factors, changes in monetary policies and capital movements, and market expectations may all interact to lead to an unexpected positive relationship between the yuan exchange rate and China's trade balance against the United States.

In sum, the positive relationship we found suggests that there are other influential factors that enhance China's competitiveness and increase its trade surplus even with the appreciation of the yuan.

### **6. Conclusion:**

This study mainly aimed to investigate whether there are effects of changes in the real effective exchange rate on China's trade balance against the United States of America using the ARDL methodology and using quarterly data extending from the first quarter of 2000 to the fourth quarter of 2022, where the study concluded that an increase in the real effective exchange rate of the Chinese yuan leads to an increase in China's trade balance surplus against the United States of America in the long term, as this result contradicts the economic literature, as previously indicated, which mostly indicates the asymmetric relationship between currency devaluation and trade balance, especially in the long term. Based on the above results of this study, we can conclude the following:

The basic research hypothesis that states that "there is a negative relationship between the impact of changes in the real effective exchange rate of the yuan and the balance of China's trade balance against the United States of America" is invalid, as this result contradicts the results obtained during previous studies presented in this study.

In view of the results reached during this study, it is in China's interest to maintain this level of the value of the yuan or at least not resort to reducing it, considering the surplus achieved with the largest trading partner, the United States of America, which contradicts the latter's claims that China is manipulating the currency and that the exchange rate of the yuan is undervalued. Therefore, the question that arises here is, where is China's interest in reducing the currency as long as the exchange rate of its currency is directly proportional to the balance of the trade balance? Therefore, through these results, we can formulate the following proposals or recommendations, hoping that they will be a starting point for subsequent studies on this topic:

\* Future research on this topic due to its great importance, using other standard models that may give Results contrary to the results of our study;

\* The necessity of the International Monetary Fund's intervention and carrying out its role for which it was established, by setting controls on foreign exchange rates. This can only be achieved through reforming the fund itself, in order to achieve equality among its members, especially with regard to the quota and voting system, so that it gains confidence, consensus and acceptance among the various countries, and then following all of those controls and arrangements proposed to be set for exchange rates.

\* The necessity of the intervention of the World Trade Organization;

\* The US authorities should focus on the imbalances in its current account and then its trade balance and not blame others, especially in light of China's new trends, especially after the internationalization of the Chinese yuan since 2016, which requires China to seek to market the image of its currency in order to make it competitive with other tradable currencies.

\*attention must be paid to the impact of RMB exchange rate fluctuations on bilateral trade balance, as large fluctuations may have negative effects. It's essential to regulate the RMB exchange rate reference more deeply, considering the currency weights in China's basket to ensure greater stability that supports the RMB's development and China's trade.

\*reducing RMB exchange rate volatility is crucial to avoid trade instability. Changes in exchange rates affect trade balance and market participants' expectations. Strengthening public expectations of RMB stability is key to maintaining a trade surplus.

\*more focus should be given to the commodity structure in China's trade relationships. RMB devaluation will not necessarily improve trade with all partners, so carefully selecting trade goods based on market demand and comparative advantage is crucial for balanced import-export relations.

\*when formulating exchange rate or trade policies, the government must consider current political and economic conditions, while creating supplementary policies that align with the overall strategy to ensure stability.

## References:

1. Belhachem Maryam. (2022). The impact of the real effective exchange rate on the Algerian trade balance: Asymmetry analysis using the NARDL model. *Roa Iktissadia Review*, 12(1).(Written in Arabic)

2. Zairi Belkacem. (2023). Balance of payments as a tool for economic analysis. Dar Ajyal Al-Raqami.).(Written in Arabic)
3. Abdel Hamid Marghit. (2019). Money and international finance. Kingdom of Saudi Arabia: Research and Studies Center.)(Written in Arabic)
4. Abdel Rahman Rawabah. (2019). An Econometric Study of the Impact of Real Exchange Rate Fluctuations of the Chinese Yuan against the US Dollar on China's Exports to the United States for the Period (2000-2016). Al-Bishr Economic Journal, 5(1), 74-91.)(Written in Arabic)
5. China Development Research Fondation. (2015). China's Exchange Rate Regime. LONDON AND NEW YORK: Routledge.
6. Figuière , C., & Guilhot , L. (2011). Évolution du rôle du yuan en Asie orientale : la guerre des monnaies aura-t-elle lieu ?
7. Frankel, J. (2022, 05 28). Views on the Economy and the World. Retrieved from HARVARD Kennedy School BELFER CENTER: <https://www.belfercenter.org/publication/get-ready-reverse-currency-wars>
8. Hu, B. (2012). Empirical Analysis of the Influence on the Sino-US Trade Balance by the RMB Real Exchange Rata. Business, Economics. Business,Economic,Financial Sciences, and Management, 367-372.
9. Islam, A. M. (2022). Yuan-Dollar Real Exchange Rate and the US Real Trade Balance with China: Long-Run Cointegration and Short-Run Dynamic Analysis. The International Trade Journal, 36(1), 43-66.
10. joon, B. S. (2008). The bilateral real exchange rates and trade between China and the US. China Economic Review, 19(2), 117-127.
11. THE WORLD BANK. (2024). World Bank national accounts data. Retrieved from [https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=US-CN&most\\_recent\\_value\\_desc=true](https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=US-CN&most_recent_value_desc=true)
12. Yu, M. (2020). China-US trade war and trade talk. Berlin, Germany: Springer.
13. Yuan, H. (2012). The Impact of CNY Real Exchange Rate of China's Bilateral Trade with the US (Doctoral dissertation. Doctoral dissertation. Malaysia: Universiti Utara.

**Appendices:**

**Appendix. 1: Limit Test**

Null hypothesis: No levels relationship Number of cointegrating variables: 2 Trend type: Rest. trend (Case 4) Sample size: 84						
Test Statistic						Value
F-statistic						10.106785
		10%		5%		1%
Sample Size	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
80	2.713	3.453	3.235	4.053	4.358	5.393
Asymptotic	3.380	4.020	3.880	4.610	4.990	5.850
* I(0) and I(1) are respectively the stationary and non-stationary bounds.						

Table No. (02) Long-term relationships

Variable *	Coefficien		t-Statistic	Prob.
	t	Std. Error		
EXCH	210487.8	112914.0	1.864143	0.0660
GDP_CH(-1)	-1.10E-05	4.00E-06	-2.749578	0.0074

GDP_US	1.94E-05	4.06E-06	4.773645	0.0000
@TREND	558403.0	147943.3	3.774439	0.0003

**Appendix. 3: Short-term Relationships**

Dependent Variable: D(BAL) Method: ARDL Date: 05/12/24 Time: 06:36 Sample: 2002Q1 2022Q4 Included observations: 84 Dependent lags: 8 (Automatic) Automatic-lag linear regressors (8 max. lags): EXCH GDP_CH GDP_US Deterministics: Unrestricted constant and restricted trend (Case 4) Model selection method: Schwarz criterion (SIC) Number of models evaluated: 5832 Selected model: ARDL(2,0,8,0)				
Variable	Coefficient t	Std. Error	t-Statistic	Prob.
COINTEQ*	-0.934754	0.127841	-7.311869	0.0000
D(BAL(-1))	0.505660	0.114588	4.412849	0.0000
D(GDP_CH)	3.42E-05	4.04E-06	8.458046	0.0000
D(GDP_CH(-1))	-5.56E-06	5.52E-06	-1.006925	0.3173
D(GDP_CH(-2))	3.14E-05	5.51E-06	5.696139	0.0000
D(GDP_CH(-3))	2.19E-05	4.34E-06	5.039244	0.0000
D(GDP_CH(-4))	1.93E-05	4.74E-06	4.075934	0.0001
D(GDP_CH(-5))	3.22E-05	6.01E-06	5.360414	0.0000
D(GDP_CH(-6))	6.88E-07	5.73E-06	0.120024	0.9048
D(GDP_CH(-7))	2.11E-05	5.69E-06	3.715281	0.0004
	-			
C	60362545	8289090.	-7.282168	0.0000
R-squared	0.934757	Mean dependent var		955990.
Adjusted R-squared	0.925819	S.D. dependent var		7
S.E. of regression	3653214.	Akaike info criterion		1341309
Sum squared resid	9.74E+14	Schwarz criterion		1
Log likelihood	-1382.630	Hannan-Quinn criter.		33.1816
F-statistic	104.5886	Durbin-Watson stat		6
Prob(F-statistic)	0.000000			33.4999
				8
				33.3096
				2
				1.94308
				4
* p-values are incompatible with t-Bounds distribution.				