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China in Terms of Exchange Rate, Inflation and Interest Rate (Based on Database 2018)

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A B S T R A C T

Along number between the exchange rate, interest rate, and inflation of the China state was studied using Autoregressive Distributed Lag (ARDL) co-integration analysis based on database 2018. Stability in the exchange regime through structurally nexus of interest rates and inflation volatility and its target is the purpose of this study. China state data from 1987-2017 based on database availability in 2018 is the main source of data for this study. Inflation and interest rates of the previous period have a significant influence on the movement of the China exchange rate, but in contrast to the movement of the exchange rate of the previous period which does not have an influence on the movement of the exchange rate of the next period. There is an indication of long-term cointegration between the independent variable and the dependent variable. The independent variables in this study are interest rates and inflation (CPI), while exchange rates are dependent variables. In the long-term relationship between independent variables there is no significant influence on the dependent variable.

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INTRODUCTION

There are many studies related to finance and economics that use theories and studies, namely the combination of exchange rates, interest rates, and inflation as explained by (Ebiringa and Anyaogu 2014). The International Fishers' Effect (IFE), Interest Rate Parity, Purchasing Power Parity (PPP), and Mundell Fleming's models are often reviewed by researchers. IFE is often used to estimate the currency of a country with a relatively high interest rate with a tendency to depreciate, while the nominal interest rate increases. This can be compared to trade with partner countries so that it can reflect the magnitude of expectations of the inflation rate.

Exchange rate volatility with periodic variations in interest rates and inflation is what is examined in this study. Ethics in predicting exchange rate movements in the long term requires several strategic steps to deal with conditions contained in the short term. This was revealed by Krugman and Obstfeld (2003). National prices play an important role in determining interest rates and relative prices on traded country products in the long term. A movement in exchange rates between the currencies of two countries with changes in price levels in that country is a description of the PPP theory. Money with a higher inflation rate can be predicted to depreciate than a currency with a lower inflation rate (Rahutami 2011). The research objectives of this study include empirically evaluating the interdependence and significance of the relationship between exchange rates, interest rates and inflation in the short term. In addition, its long-term sustainability is a research objective that focuses on China case studies.

LITERATURE REVIEW

Purchasing Power Parity (PPP). The adjustment of the exchange rate over time that is useful for accommodating differences in inflation between countries is the point of view of the PPP theory as explained by Rahutami (2011). The difference in the price of this item can be converted into one currency to another, for example using the same currency unit, namely the dollar. PPP uses exchange rates that compare domestic prices (Pd) with foreign prices (Pf). The price when viewed from the mathematical equation is shown as follows:

$$P = \frac{P_d}{P_f} \quad (1)$$

The reason that is often stated when testing PPP according to Holmes (2001) is:

1. PPP as a predictive model for exchange rates and used as a criterion to decide the nature of currencies (undervalued or overvalued). Developing countries that have an open but small economic economy is more relevant to describe the conditions of the PPP model. This is because developing countries have a strong difference in inflation when viewed from domestic inflation with inflation abroad.
2. PPP is used in exchange rate theory. There are many obstacles and problems found in empirical research according to Rahutami (2011). Rationalization of the concept of PPP whose exchange rate is based on the law of one price is the cause of problems in PPP. The important problems are:

a. Bis non-zero transportation while barriers in trade are still widely found.
b. In the market there are monopolies and oligopolies that distort free trade.
c. PPP is relatively inefficient for predicting exchange rates due to differences in the concept of measuring inflation between countries.

Frame of Mind. The years 1987-2017 was the observation period in this study using the 2018 database. China exchange rate trends tend to fluctuate throughout the year. Influential factors are reviewed through variables of China exchange rates, China interest rates, and China inflation. This research model examines the long-term relationship between exchange rates, interest rates, and inflation through Autoregressive Distributed Lag (ARDL) co-integration analysis. The ability of the exchange regime through the structurally nexus of interest rate and inflation volatility and its target needs to be as certained.

Alignment with economic theory as well as research that has been done in the previous year is needed to build research hypotheses. The result of the adjustment of the hypothesis refers to several previous literatures, among others.

1. The China exchange rate is positively influenced by the China inflation.
2. The China exchange rate is negatively affected by the increase in China interest rates.
3. The China exchange rate was positively influenced by the China exchange rate of the previous period.

METHODOLOGY

Data Types and Sources. Secondary to this study from the World Development Indicators which examines China countries using time series data from 1987-2017 based on 2018 database. Exchange rate, real interest rate, consumer price index (CPI), and lag of exchange rate are the variables studied.

Table 1. Research Data Sources

Variable	Data sources
Exchange Rate	*World Development Indicators*
Real Interest Rate (RIR)	
CPI	

Data Analysis and Processing Methods. Descriptive analysis of this research uses literature study and understanding of theory to support research, while a quantitative analysis is used to determine the stability of the exchange rate regime due to the influence of interest rates and inflation. Data processing through Microsoft Excel 2013 and Eviews-9 software. One form of econometric model introduced by Pesaran and Shin (1997) is Autoregressive Distributed Lag (ARDL). The purpose of its use is to analyze long-term relationships involving the concept of cointegration among time series variables. The exchange rate (EXR) is dependent while the interest rate (INT), Consumer Price Index (CPI),

and the lag of the exchange rate (EXR_{t-1}) are independent variables. This research model was adopted from Ebiringa and Nnneka (2014), namely:

$$EXR_t = \alpha 0 + \alpha 1\ INT_t + \alpha 2\ CPI_t + \alpha 3\ EXR_{t-1} + E_t \quad (2)$$

EXR : Exchange rate (percent)
INT : Interest rate (percent)
CPI : Consumer Price Index (persen)
EXR_{t-1} : Lag of exchange rates

The steps performed in this method are:

- **Stationarity Test**. Stationarity tests are performed with the Augmented Dickey Fuller Test (ADF). The hypotheses used in this ADF Test are: The null hypothesis (H0) states that the data has a unit root and the Hypothesis one (H1) states that the data has no unit roots. Data is considered stationary if the results show H0 repulsion, which is when the t-static value is smaller than the critical value at a real level of 5% or 10%. In addition, when the P-value is smaller than the real level of 5% or 10%.
- **Bound Test.** Cointegration in the ARDL method uses the Bound Test to review whether there is a cointegration relationship between variables that are not stationary at the data level. There is a critical value, yes, it is a lower bound critical value and an upper bound critical value according to Pesaran *et al.* (2011). Cointegration occurs when the F-Statistic is above the critical value, and vice versa. F-Statistics is between these two critical values, so the results cannot be concluded.
- **ARDL Estimation Test.** The ARDL Estimation Test is carried out if there is a cointegration of the results of the Bound Test with model testing seen from the different lag of each variable according to the optimum lag test results. R-square to determine the influence of the independent variable on the model on the dependent variable, while the measurement of the validity of the model is reviewed from the statistic F-value, and reviews the significant influence between the independent variable in the model on the dependent variable through P-value, as well as reviewing auto correlation on models can use Durbin-Watson (DW).
- **Optimal Lag Test.** Optimum Lag Test is performed to find the optimal lag combination to produce the best ARDL model. Optimal lag was selected based on the base values of Akaike Information Center (AIC), Schwarz Bayesian Criterion (SC), and Hanne Quinn (HQ). According to Pesaran and Shin (1997) in Apriyanto (2016), ARDL-AIC and ARDL-SC showed better proficiency in the majority of experiments conducted. In this study, the ARDL-AIC Test will be performed to determine the best lag combination to form a model.
- **Test Short-Term and Long-Term Relationships.** Each independent variable on the influence of the dependent variable in the model was reviewed using short-term and long-term relationship tests. The effect of independent variable on the dependent variable can be viewed from the coefficient on the independent variable. The significant of each independent variable is assessed from the P-value in the long-term relationship test.

RESEARCH RESULT

The stationarity test is the first step in analyzing time series data. The Augmented Dickey Fuller (ADF) test was used in this study. The null hypothesis (H_0) indicates a unit root in the data, while the first hypothesis (H_1) does not find a unit root in the data. If the data does not have a unit root or rejects the null hypothesis, the data is stationary, that is, the probability value is less than the significant level (5% or 10%).

Table 2. Stationary Tests

Null Hypothesis: CPI has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, max lag = 7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.722619	0.0090
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

CPI inflation

Null Hypothesis: D (ER) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic – based on SIC, max lag = 7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.724941	0.0007
Test critical values:			
	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

Exchange Rate

Null Hypothesis: RIR has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, max lag = 7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.113496	0.0362
Test critical values:	1% level	-3.670170	
	5% level	-2.963972	
	10% level	-2.621007	

Real Interest Rate

The three variables used in this study are stationary according to the results shown in Table 2. The variables that are stationary at the level are the Consumer Price Index and the Real Interest Rate, while the variable that has a stationary value at the first difference is the Exchange Rate variable. The best model chosen was ARDL (4,4,3) with the Akaike Info Criterion (AIC) method.

Table 3. ARDL Test Results

Dependent Variable: ER

Included observations: 27 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
ER(-1)	0.303393	0.189598	1.600192	0.1336
ER(-2)	0.208459	0.162464	1.283109	0.2219
ER(-3)	0.230647	0.168077	1.372274	0.1932
ER(-4)	0.213801	0.139773	1.529637	0.1501
CPI	0.201975	0.054231	3.724358	0.0025
CPI(-1)	-0.007246	0.065930	-0.109902	0.9142
CPI(-2)	0.042619	0.032817	1.298709	0.2166
CPI(-3)	0.098668	0.033036	2.986672	0.0105
CPI(-4)	-0.062263	0.017475	-3.563019	0.0035
RIR	0.106186	0.061307	1.732037	0.1069
RIR(-1)	0.039854	0.055866	0.713393	0.4882
RIR(-2)	0.057708	0.037449	1.540951	0.1473
RIR(-3)	0.162938	0.041227	3.952211	0.0017
C	-1.377778	0.648966	-2.123034	0.0535

R-squared	0.957100	Mean dependent var	7.303222
Adjusted R-squared	0.914199	S.D. dependent var	1.057638
S.E. of regression	0.309800	Akaike info criterion	0.800372
Sum squared resid	1.247691	Schwarz criterion	1.472288
Log likelihood	3.194975	Hannan-Quinn criter.	1.000168
F-statistic	22.30989	Durbin-Watson stat	1.394339
Prob(F-statistic)	0.000001		

Source : E-views 9 (processed)

$$ER = 0.30ERt{-}1 + 0.20ERt{-}2 + 0.23ERt{-}3 + 0.20CPIt - 0.007CPIt{-}1 + 0.04CPIt{-}2 + 0.09CPIt{-}3 - 0.06CPIt{-}4 + 0.1RIRt + 0.03RIRt{-}1 + 0.05RIRt{-}2 + 0.16RIRt{-}3 - 1.377$$

Inflationary trend or CPI has a positive effect on the exchange rate, while the real interest rate or RIR has no significant effect even though it has a positive sign on the exchange rate with a real level of 5% as shown in Table 3. The CPI t-statistic value is 3.724 with a probability of 0.0025 and the RIR t-statistic of 1.73 and a probability of 0.106 which indicates that there is no significant relationship between the CPI and the unacceptable exchange rate. There is no significant relationship between real interest rates and exchange rates, so it cannot be rejected (null hypothesis).

The R-square value is 0.95 indicating that the dependent variable (exchange rate) is influenced by the Consumer Price Index (CPI) and Real Interest Rate (RIR) of 95% while the rest is influenced by other variables outside the model. The independent variables together being able to explain the dependent variable are indicated by the F-statistical value of 22.3 or a probability value of 0.000.

Movements in the previous period's exchange rate had a positive but not significant effect on future exchange rate conditions as indicated by the results of estimating all lags of the exchange rate with a probability greater than the 5% real level (0.13 ; 0.22 ; 0.19 ; 0.15). The cause is due to the movement of the t-period CPI and the previous period's CPI, and is influenced by the 3rd and 4th CPI lags with probabilities of 0.01 and 0.0035 respectively. CPI lag period t-3 has a positive and significant effect on exchange rate movements and lag CPI t-4 has a negative and significant effect. In contrast to the lag CPI t-1 and t-2 do not significantly affect exchange rate movements. The movement of the exchange rate is influenced by the real interest rate variable or RIR, namely the lag RIR period t-3 has a positive and significant effect on the movement of the Chinese exchange rate with a probability of 0.0017.

Table 4. Bound Test

Test Statistic	Value	k
F-statistic	14.05428	2

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	3.17	4.14
5%	3.79	4.85
2.5%	4.41	5.52
1%	5.15	6.36

Source : E-views 9 (processed)

Cointegration Test is needed to test the non-stationary of variables at the data level that are cointegrated between one variable and another. The cointegration of the ARDL model through the Bound Test by Pesaran *et al* (2011) has lower critical values and upper bound values. Cointegration occurs because the F-statistic is above the upper bound, vice versa cointegration does not occur if the F-statistic is below the lower bound. It cannot be concluded if the F-statistic is between these two critical values. Based on Table 4, it can be seen that the bound test results show a cointegration in the model because the F-statistic value is 14.05 and is greater than the upper bound (6.36).

There is no significant long-term effect on the 5% significance level of the independent variables (real interest rates and CPI) in terms of the dependent variable (exchange rate). The CPI probability value is 0.58 and the RIR probability value is 0.57, causing the two variables to have no significant effect on exchange

rate movements for long-term periods. This indicates that there is no balance in the longterm relationship.

Table 5. Long-Term Relationships

Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
CPI	6.264412	11.106979	0.564007	0.5823
RIR	8.391020	14.615930	0.574101	0.5757
C	-31.528241	68.337911	-0.461358	0.6522

Source: E-views 9 (processed)

DISCUSSION

PPP is a model that is reviewed over the long term to determine the equilibrium level of exchange rates when viewed from a theoretical perspective. Through the PPP approach that considers the existence of certain commodities to have the same price tending around the world when using the measurement system that is with the same currency. The law of one price is the right designation to describe the condition.

The condition of selling goods with identical types of goods whose selling prices are the same in all locations of sale of these goods while the price is set in the same currency is the definition of the law of one price. One reason is because there are no obstacles as a result of small transportation costs so that the price of commodities or services has the same tendency in every market. The implementation of the law of one price if operational conditions in the national market and international market run well. Arbitration enforcement is able to remove price differences between different geographical locations very quickly.

Each country has a different currency unit, so that differences in each country's currency have an impact on the price of commodities or services will be expressed in the currency of each country. Although there are different units of currency in each country, the price of goods traded is relatively the same. Countries that have the same exchange rate because of the price level agreed by both countries in order to transact (Mankiw 2006). This study used the China exchange rate. The official exchange rate is guided by exchange rates based on national authorities as a result of the market valuation according to the World Development Indicators in the World Bank group (2015). According to Mankiw (2006); Blanchard and Johnson (2012) if the exchange rate appreciates, foreign goods are relatively cheaper while domestic goods are relatively more expensive. Conversely, the depreciating exchange rate causes foreign goods to be relatively more expensive than domestic goods which are relatively cheaper.

Exchange rates have a positive effect on stock prices for the long term (Karni 2018). Domestic products are relatively cheap as the China yuan depreciates so people's preference for domestic product increases, followed by rising corporate

profits. The implication for investors' attractiveness to buy stocks is rising and stock prices are also trending upward. Short-term exchange rate percentage changes are positively though not significantly related to inflation in the Indonesian case study (Langi *et al*, 2014).

Increasing the money supply that has implications for increased liquidity in an economy is the definition of inflation. Increases the money supply so as to increase prices (Karni 2018). Sutawijaya (2012) found that the exchange rate has a positive and significant effect on inflation. Inflation has increased since 2005-2013 followed by an increase in the money supply in the community. An increasing money supply can suppress the value of the currency against the value of other countries' currencies (depreciation), and vice versa.

High inflation has led to the withdrawal of the remaining funds in savings to cover rising prices of domestic goods and rising levels of China consumption. Reduced savings rates such as private, government and public savings can lower investment rates in the short term and thus cause the China yuan to depreciate. Mankiw (2007) states that inflation is a change in the price level related to Peru's material purchasing power or value of money. Rising China inflation causes an increase in the price of a number of goods or the value of domestic China money has low purchasing power. The implication is that the higher China's inflation, the China yuan's exchange rate will depreciate, and vice versa.

The increase in the interest rate of money encourages people to keep funds in banks so that the bank's ability to disburse credit increases. As a result, lending rates have also increased, which has implications for people's desire to borrow loans from banks. According to Blanchard and Johnson (2012), rising interest rates then lead to a decrease in demand for goods and a decrease in output. The interest rate that affects spending and output (via IS) is the real interest rate. High interest rates will lower investment.

The desire of the China people to keep money in the Bank is getting higher and higher so that the circulation of the China yuan currency is getting less and less. This has implications for the China yuan currency which is appreciating. Conversely, low interest rates will increase investment. The desire of the China people to keep money in the Bank has decreased so that the circulation of the China yuan currency is increasing. This has implications for the depreciating China yuan currency. Nofiatin (2013) explained that too much money supply in society indicates that the country's economy is in poor condition. The implication is that the exchange rate is depreciating or weakening against foreign currencies and inflation in the country is increasing. One of the efforts that can be done by the Central Bank is to raise interest rates to absorb excess liquidity in the community.

CONCLUSIONS AND RECOMMENDATIONS

The relationship between exchange rates, interest rates and inflation reflected by CPI in China based on the 2018 database was examined using an Autoregressive Distributed Lag (ARDL) approach that integrates variables. Inflation and interest rates in the previous period had a significant effect on the movement of the China exchange rate, while the movement of the exchange rate

in the previous period did not affect the movement of the exchange rate in the next period. Although there is a long-term cointegration between the independent variable, namely interest rates and inflation (CPI) against the dependent variable, namely the exchange rate, there is no long-term relationship between the independent variables that significantly affect the dependent variable.

ADVANCED RESEARCH

Each study has limitations. This research based on database 2018. The destination countries in this study only focus on China.

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