

## Testing Purchasing Power Parity (PPP) to examine Economic Openness of Australian Economy

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**Abstract:** This paper examines Purchasing Power Parity (PPP) with a variation of the Vector Error Correction Model (VECM) which guesses that an affiliation exists among Real Exchange Rate, Interest Rate, and Inflation Rate in Australia. The objective of this assessment is to research how much the picked macroeconomic elements influence the Real Exchange Rate of Australia by using the Johansen long-run testing way to deal with management co-integration. The paper shows enchanting estimations. ADF unit root test has been adopted to determine whether broad data is fixed or not. By testing the Johansen test for co-integration, the paper shows the association between Real Exchange Rate, Interest Rate, and Inflation Rate in Australia. VECM is also adopted to test the short-run components of the Real Exchange Rate work. Cumulative Sum (CUSUM) and Cumulative Sum of Square (CUSUMQ) have been used to test the quality of the model. The results show short-run and long-run relationship among Real Exchange Rate, Inflation Rate, and Interest Rate. The results showed that the Inflation Rate adversely influences the Real Exchange Rate, notwithstanding, Interest Rate has a Positive effect. Additionally, the Inflation Rate has a free causal relationship with Real Exchange Rate, be that as it may, Interest Rate has a unidirectional relationship. This paper prescribes the likelihood to improve their Real Exchange Rate by reducing the Inflation Rate and growing the Interest Rate.

**Key words:** Australia, PPP, ADF, Unit Root, VECM, Regression, Johansen test, CUSUM, CUSUMQ, Exchange Rate, Inflation Rate, Interest Rate

### I. Introduction

Purchasing Power Parity (PPP) is presumably one of the vastly stabilized and most discussed hypotheses in the field of international economics. The paper intends to analyze whether the PPP condition fits in the economy of Australia. PPP underlines that differing national worth degrees should be comparable when conveyed in the run of the mill cash. The authenticity of the PPP implies that whether the two countries are financially organized. Likewise, the PPP theory between the Nominal Exchange Rate (NER) and Relative Consumer Price (RCP) quantifies a long-run estimation of money. In this manner, PPP assesses the viability of the outside trade showcase. Australia is a developed country and dynamically their Purchasing Power Parity is reducing the

aftereffect of its Inflation Rate but Interest Rate increases slowly. The Inflation Rate is the rate at which cash is limited during a period. Additionally, the Interest Rate is the amount the banks charge for the course of the preferences revealed as a degree of the head. Besides the Exchange Rate is the estimation of one money between times of another cash. This paper depends on Australian Purchasing Power Parity where dependent variable is Exchange Rate and the Independent factors are Inflation Rate and Interest Rate. The Inflation Rate and Interest Rates are markers of the transformation standard.

## II. Literature Review

Soofi (1998) and Edwards (1989) mentioned the Exchange rate as one of the significant macroeconomic factors because it influences economic activity, imports, inflation, and exports of a nation and between nations. Cassel (1916) studies that exchange rate between two countries is directed by the extent between the general worth levels of the countries. Copeland (2005) expressed that one of the longest stretch conversion standard models in the economy is Purchasing Power Parity (PPP), which shows obscure results considering the way that, in most of the tests, the speculation isn't affirmed. Dornbusch (1982) claims that PPP-situated conversion standard approaches have been generally received among creating nations as a method of surveying the remote exchange segment, despite the fact that it is likewise applied in evolved nations. Alba (2005) inspected long-run PPP utilizing a board Unit Root test in the US dollar real exchange rate of 84 developed and developing nations and researched the legitimacy of the PPP theory for the period 1976-2002. As indicated by their decision, PPP is legitimate in Europe and Latin America, it is invalid in Africa and Asia. Çağlayan (2006) have examined the PPP theory by utilizing Unit Root and ECM tests for Turkey and the United Kingdom somewhere in the range of 1995 and 2004. As per the outcome they acquired, it is invalid. Basher (2007) has analyzed whether the real exchange rate is steady by utilizing Unit Root tests for 17 nations of Organisation for Economic Co-operation and Development (OECD). They took note of information for the period 1973: Q1-1998Q4. Thus, it is presumed that the PPP speculation is substantial. P. K. Narayan et al. (2009) inspected the period somewhere in the range of 1973 and 2002. Thus, the PPP theory of 14 nations is substantial. Tatoğlu (2009) analyzed the legitimacy of the PPP speculation utilizing broad Unit Root tests for 25 OECD (Organisation for Economic Co-operation and Development) nations for utilizing information between 1977-2004. The PPP speculation is substantial. Hüseyin Kalyoncu et al. (2010) utilizing official and bootleg market real exchange rates information from thirteen MENA nations analyzed over the period 1970-1998 to test for proof of PPP. The PPP remains constant for ten nations out of thirteen nations. Ismail Cevis et al. (2015) utilized the cointegration test to look at the legitimacy of PPP for the delicate five utilizing information from, accordingly, the PPP is substantial in India, Brazil, South Africa, and Turkey. Ümit (2016) explored the legitimacy of PPP for the period somewhere in the range of 2003:01 and 201 S: 10. Thus, the PPP theory is invalid for South Africa and India. Enders (2004) imposed PPP with ordinary ostensible exchange rates and CPI, manipulating month to month evidence, for Thailand, Malaysia, Singapore, Hong Kong, Philippines, Indonesia, and Korea manipulating Japan and USA as quotation nations, for the period from 1973.1 to 2001.7, with the Philippines with information up to 2001.6; Malaysia with information up to 2001.4; Indonesia with information up to 2000.12 and Hong Kong with information up to 2001.6. Cuestas (2013) studied whether the PPP hypothesis in the Organisation for Economic Co-operation and Development (OECD) nations is genuine for the period 1972:01-2010:01 by utilizing the straightforward and nonlinear Unit Root test. As per the experimental outcomes, while it is valid in 11 nations, it is invalid in Turkey. Frenkel (1981) interpreted that modification scale of G-7 nations in 1970 didn't bolster the estimate of PPP hypothesis. Dornbusch (1985) finishes up with an audit of the ramifications of PPP inconsistencies which is a petition to widespread genuine salary correlations, loan fee linkages, and transformation standard approach. Chi-Wei Su et al. (2012) analyzed both straight and nonlinear Unit Root tests with fixed covariates to test the legality of long-run purchasing power parity for the BRICS nations from 1996 to 2010. The outcomes show that PPP remains lasting for all BRICS nations.

### III. Objectives

The motivation behind the examination is to investigate the components that impact PPP in Australia based on Vector Error Correction Model (VECM), by utilizing the Johansen long-run testing way to deal with co-integration so as to decide the likely impacts in the connection between Real Exchange Rates, Inflation Rate, and Interest Rate in this way assessing how Real Exchange Rates react to changes in Inflation Rate and Interest Rate. Assessing the soundness of Real Exchange Rates in Australia and prescribe strategy rules to improve exchange balance crumbling in Australia.

### IV. Methodology

This paper is based on time series data which is quantitative and qualitative in nature. Secondary data is collected from different sources. Various tests have been done to determine the quality of data and find out the ultimate objective of this paper. The ADF test has been driven to examine the stationary state of the data set. The Johansen test has been applied to determine the long-term, short term, and nominal relationship among variables (Real Exchange Rate, Inflation Rate, and Interest Rate). VECM, CUSUM, and CUSUMQ tests have been applied to test the stability of the relationships among variables. Granger Causality is used to indicate a way to investigate causality between two variables in a time series or to identify one time series which is useful to anticipate another. Also has been used Regression tests to investigate the trends of the data set.

### V. Results & Discussions

The Augmented Dicky Fuller (ADF) Unit Root test shows that (**Table 01**) the t- statistics (6.75) are > critical test @5% level (2.94) this means the data are stationary. Therefore, those do not have a trend or seasonal effects.

**Table 01: Augmented Dicky Fuller (ADF) Unit Root Test**

Null Hypothesis: D(Real Exchange Rate,2) has a unit root			
Exogenous: Constant			
Lag Length: 1 (Automatic - based on SIC, maxlag=10)			
		t-Stat	Prob.*
ADF test statistic		6.746732	0.00
Critical values:	Level at 1%	3.621023	
	Level at 5%	2.943427	
	Level at 10%	2.610263	
*MacKinnon (1996) one-sided p-values.			

Source: Estimated

The Johansen test (**Table 02**) illustrates that there is a long-term relationship where at most one co-integration equation exists. The trace value of the null hypothesis at most 1 is (10.54) which is less than 0.05 critical values (15.49). In the long run normalized co-integration (**Table 03**) shows an adverse Impact of interest rate, whereas the Interest Rate has a Positive Impact. The coefficient is statistically significant @1% level.

**Table 02: Johansen Test**

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	00.32	25.34810	28.80	00.15	14.80528	20.13	00.30
At most 1 *	00.14	09.54282	14.49	00.24	5.751946	13.26	00.65
At most 2	00.12	4.790874	2.84	00.03	4.790874	2.84	00.03

Source: Estimated

**Table 03: Johansen Test**

Normalized Co-integrating Coefficients(Standard Error in Parentheses)		
Real Exchange Rate	Inflation Rate	Interest Rate
1.00	00.00	00.20
		(0.08352)
0.000000	1.000000	-1.903186
		(0.68497)
Adjustment Coefficients (Standard Error in Parentheses)		
D(Real Exchange Rate)	-00.09	-00.01
	(00.06)	(00.01)
D(Inflation Rate)	-3.652147	-0.362196
	(1.14101)	(0.14452)
D(Interest Rate)	-0.481742	0.058962
	(1.09105)	(0.13819)

Source: Estimated

Granger causality test (Table 04) shows three causalities between our variables:

- “Inflation Rate does not granger cause Real Exchange Rate” is not rejected as probability is more than 0.05 and the same for the “Real Exchange Rate to Inflation (Independent Relationship)”.
- “Interest Rate does not granger cause Real Exchange Rate” is not rejected because probability value is more than 0.05 (Independent Relationship).
- “Interest Rate does not granger cause Inflation Rate” is not rejected but “Inflation Rate does not granger cause Interest Rate” is rejected. So, there is a unidirectional causal relationship.

**Table 04: Granger Causality Test**

Sample: 1970-2010			
Lags: 2			
Null Hypothesis:	Observation	F-Stat	Probability
InflationRate Does Not Granger Cause RealExchangeRate	39	1.10729	0.3421
RealExchangeRate Does Not Granger Cause InflationRate		3.48663	00.04
Interest Rate Does Not Granger Cause Real Exchange Rate	39	00.32	00.73
Real Exchange Rate Does Not Granger Cause Interest Rate		01.30	00.29
Interest Rate Does Not Granger Cause Inflation Rate	39	3.08422	00.06
Inflation Rate Does Not Granger Cause Interest Rate		2.77382	00.08

Source: Estimated

Vector Error Correction Model demonstrates the data is stationary, there is existing a long-term relationship, VECM is exploited to find out the stability among our variable. The first table is for long-run relationships and the second one is for short-run relationships. In a long-run relationship (Table 05) a 1% change in the Inflation Rate decreases the Real Exchange Rate by 5.44%. With a 1% change in an Interest Rate with a fall of 1.18% in the Real Exchange Rate. Past year's variance from long-run equilibrium is rectified at an adaptable speed of -0.144850%. In the short run relationship (Table 06) a percent alteration in Inflation Rate is combined with a -

0.015125% increase in the Real Exchange Rate. Finally, a percent change in Interest Rate is combined with 0.020428%, an increase in Real Exchange Rate.

**Table 05: Vector Error Correction Model (ECM)**

Co-integrating Equation:	CointEq1
RealExchangeRate (-1)	1.000000
Inflation Rate (-1)	0.095707
	(0.01760)
	[ 5.43679]
Interest Rate (-1)	-0.017077
	(0.01737)
	[-0.98298]
C	-1.662141

Source: Estimated

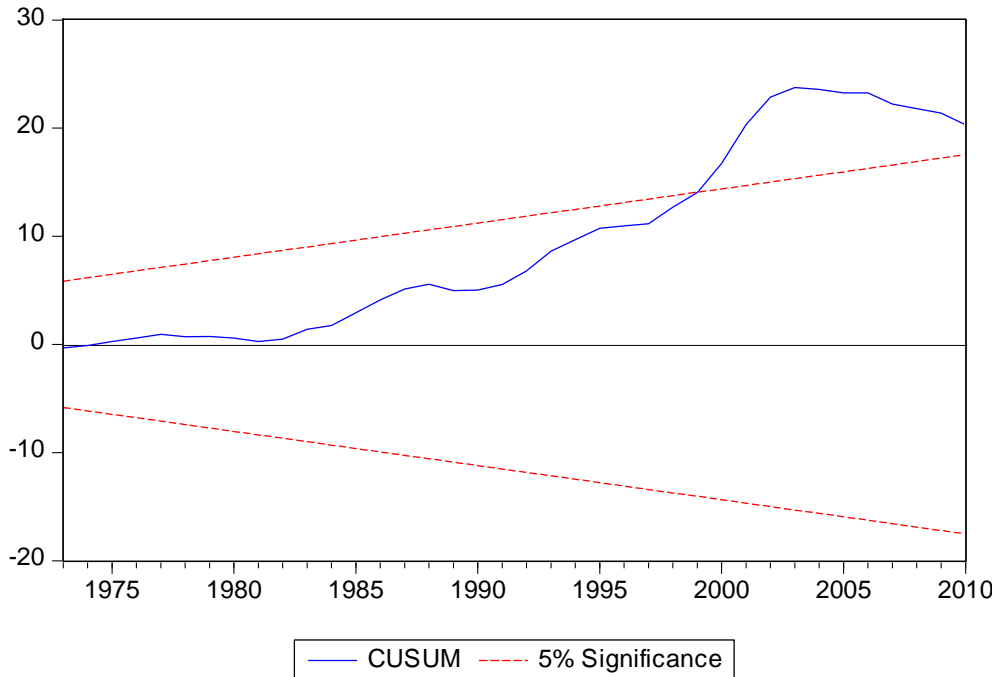
**Table 06: ECM**

Error Correction	RealExchangeRate	Inflation Rate	Interest Rate
Co-integrating Equation 1	-0.144850	-5.144292	-1.143114
D(RealExchangeRate (-2))	0.467113	-2.618551	-3.086008
D(Inflation Rate (-2))	-00.02	-00.10	00.25
D(Interest Rate (-2))	00.02	00.36	00.41
C	0.002310	0.004557	-0.048714

Source: Estimated

CUSUM & CUSUMQ shows that the Inflation negatively Impacts on Real Exchange Rate although Interest Rate positively impacts on Real Exchange Rate. There are a strong short term and long-term relationship among variable and CUSUM & CUSUM square (**Figure 01 & 02**) the test suggests that those data are stable over the year (1970-2010).

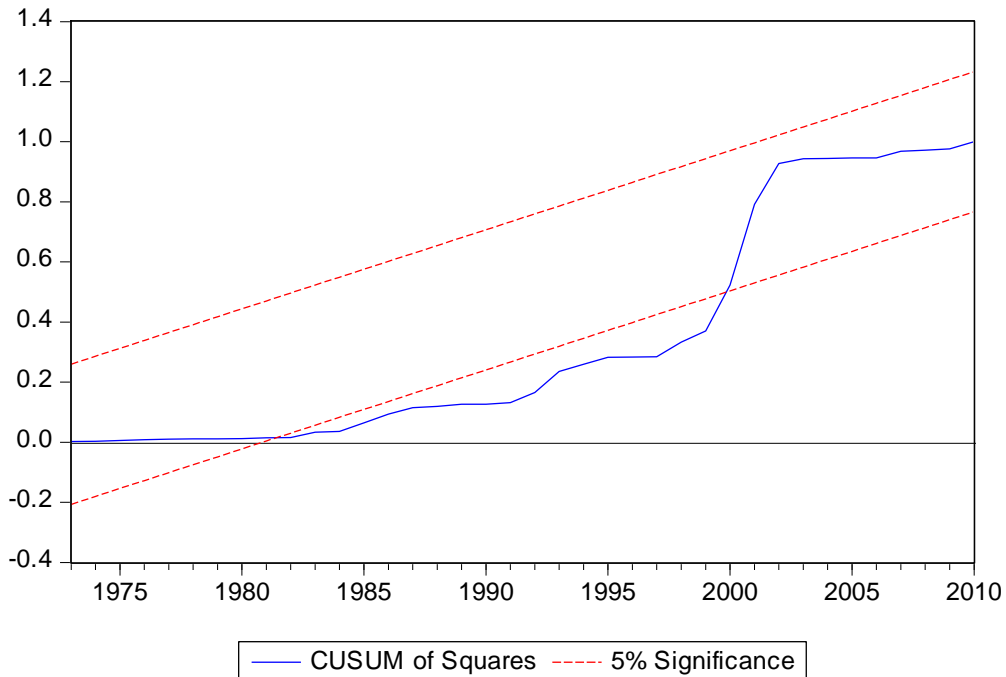
**Figure01: CUSUM Test**



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*Source: Estimated*

**Figure02: CUSUMQ Test**



*Source: Estimated*

Regression model (**Table 07**) found that the R square value is 0.454846 and from this, it is concluded that 45.48% of variation independent variable of Real Exchange rate is explained by independent variables which are Inflation Rate and Interest Rate. This hints a strong explanatory power of the regression. F-statistics show

independent variables are very significant to obtain dependent variables. And the probability value is lower than 0.05%, which directly indicate the significance of variables.

**Table 07: Regression**

Variables	Coefficients	Std. Errors	T-Stat.	Probabilities
<b>Inflation Rate</b>	-00.06	00.01	5.410567	00.00
<b>Interest Rate</b>	0.020975	0.011215	1.870249	0.0692
<b>C</b>	1.392096	0.087118	15.97943	0.0000
<b>R Squared</b>	00.45			
<b>Adjusted R-squared</b>	00.43			
<b>S.E. of Regression</b>	00.23			
<b>Sum Squared Resid</b>	2.068340			
<b>S.D. Dependent VAR</b>	0.307979			
<b>F-statistic</b>	15.85255			
<b>Prob(F-statistic)</b>	0.000010			
<b>Mean dependent VAR</b>	1.215367			

*Source: Estimated*

### **Conclusion & Policy Recommendations**

Australia is a developed nation that has a formulating business section for the economy. They have sufficient properties and an effortless monetary condition, yet, bit by bit their Real Exchange Rate is lessening. This paper depends on their Purchasing Power Parity to decide the assessment of the cash and the aspects which are accountable for lessening the appraisal of money. The aftereffects of this paper show that Inflation Rate negatively influences their Real Exchange Rate and Interest Rate has a Positive Influence. The Inflation Rate has a self-sufficient causal relationship with Real Exchange Rate, be that as it may, Interest Rate has a unidirectional relationship. In addition to this long-run and short-run relationships also exist. Their Inflation Rate is deliberately widening which is the fundamental factor for lessening Real Exchange Rate. Interest Rate is also gradually shrinking. It Positively Impacts on Real Exchange Rate, yet for being bit by bit curtailing it is moreover an issue for curtailing Real Exchange Rate. This paper directs that there are still chances to improve their Real Exchange Rate by curtailing the Inflation Rate and broadening Interest Rate. For additional examination might be coordinated to consider the justification for the expanding Inflation Rate and curtailing Interest Rates.

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