

MEASURING GRANGER CASUAL RELATIONSHIP BETWEEN THE EXCHANGE RATES OF INDIAN AND SRILANKAN RUPEES AGAINST THE U.S. DOLLAR

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Abstract *The present study is undertaken to find out whether there exists any Granger Casual relationship between the exchange rates of Indian rupees (Indr) and SriLankan rupees (Slknr) against the U.S. dollar. To accomplish the objectives of the study secondary data have been collected on daily basis and run from 3rd of Jan. 2000 to 20th June 2014. Standard econometrics techniques like ADF unit root test, VAR model and Granger Casualty Test have been applied to test the Granger Casual relationship of Indian and SriLankan rupees against the U.S. dollar. The results of the study show very little evidence of casual relationship between the exchange rates of two currencies against the U.S. dollar.*

Keyword: *Granger Casualty, VAR, Unit Root, ADF, U.S. Dollar, Exchange Rates*

INTRODUCTION

Exchange rates are considered as a key indicator for the development of a country. The stability in exchange rates and continuous growth in capital market are necessary for financial system's stability and monetary policy effectiveness. The financial systems of India and SriLanka have improved significantly, moving from fragmented to relative efficient system. As the capital markets of both the countries are growing rapidly all over the world. So, the present study is quite imperative. The present study is undertaken to assess the Granger Casual relationship between currencies exchange rates of Indian and SriLankan rupees against the U.S. dollar.

LITERATURE REVIEW

In the present era, the existence of relationship between currencies exchange rates of different countries against the U.S. Dollar has received considerable attention. It has been observed since long that theoretical consensus is still solvable. In the similar manner empirical studies are conducted by different researchers using different historical data of several economies. In the present study an attempt has been made to present the mixed results of some empirical studies carried on by number of scholars, academicians and authors pertaining to currencies exchange rates of different countries against the U.S. dollar.

Aydemir & Demirhan (2009) investigated the casual relationship between stock prices and exchange rates. To fulfill the objectives of the study, secondary data were collected from Turkey Stock Exchange w.e.f. 23 February 2001 to 11 January 2008. For analysing the data Augmented Dicky-Fullers (ADF), Phillips-Perron (PP) and KPSS tests were run. The result of the study shows that there exists a negative casual relationship between exchange rates and all stock market indices.

Mohammad, Hussain & Ali (2009) observed that exchange rate and exchange reserve significantly influenced the stock prices in Pakistan. They opine that there is a strong affiliation between macroeconomic variables and Karachi Stock Exchange rates taking into consideration quarterly data of foreign exchange rates.

Caporale, Pittis & Spangnolo (2002) examine the casual relationship between stock prices and exchange rates volatility in four East Asian countries. The result of their studies shows that there exists negative relationship between exchange rates and stock prices in Japan and South Korea, while in Indonesia and Thailand they were positively associated.

Yang & Doong (2004) opine that movement of stock prices will affect future exchange rates movements. On the other hand changes in exchange rates will have less impact on future stock prices.

Gavin (1989) and Soros (2009) observed that movements in stock market may also affect exchange rates. They are

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of the opinion that equities being part of wealth, may affect the behaviour of exchange rates through the demand for money according to the monetarist model of exchange rates determination.

Rashid (2007) investigated the cause and effect association between exchange rates and stock prices for Pakistan. For data analysis, he used co-integration, Granger causality tests and Vector error correction modeling technique. The data used were completely secondary in nature and were collected weekly from 70 individual securities and the trade-weighted exchange rates over the span from January 1, 1999 to March 31, 2004. The result of the study shows that there is no long run equilibrium relationship between the trade weighted exchange rate and the stock prices for about 86% examined firms. Only five firms out of total sample shows a long run stable relationship between exchange rates and stock prices.

METHODOLOGY

Data Collection

To accomplish the objectives of the study only secondary data have been collected on daily basis (Monday to Friday) and run from January 3, 2000 to June 20, 2014.

Statistical Tools

Standard econometrics techniques like Augmented Dicky-Fullers Unit Root Test, VAR Model and Granger Causality Test have been applied for data analysis.

OBJECTIVES OF THE STUDY

The present study is undertaken with the following objectives in view

1. To find out whether the time series data is stationery or non stationery.

2. To empirically verify the random walk movements of Indian and SriLankan rupee against the U.S. dollar
3. To measure Granger Causal relationship between the exchange rates of Indian rupee (Indr) and SriLankan rupees (slknr) against the U.S. dollar.

Limitations of the Study

The present study suffers from the following limitations.

1. The scope of the study is restricted to exchange rates of Indian and SriLankan rupee against U.S. dollar only.
2. Possibility of subjective interpretations cannot be ruled out.

TESTING OF UNIT ROOT

Unit root may be defined as a process that evolves through time and can cause problems in statistical inference involving time series models. Every linear stochastic process has a unit root if 1 is a root of the process's characteristic equation. Such a process is non-stationary. If the other roots of the characteristic equation lie inside the unit circle-that is, have a modulus less than one-then the first difference of the process will be stationary. Take a discrete-time stochastic process $\{y_t, t = 1, \dots, \infty\}$, and suppose that it can be written as an autoregressive process of order p :

$$y_t = a_1y_{t-1} + a_2y_{t-2} + \dots + a_p y_{t-p} + \epsilon_t.$$

Here, $\{\epsilon_t, t = 0, \infty\}$ is a serially uncorrelated, mean zero stochastic process with constant variance σ^2 . For convenience, assume $y_0 = 0$. If $m = 1$ is a root of the characteristic equation:

$$m^p - m^{p-1} a_1 - m^{p-2} a_2 - \dots - a_p = 0$$

then the stochastic process has a unit root .

Fig. 1

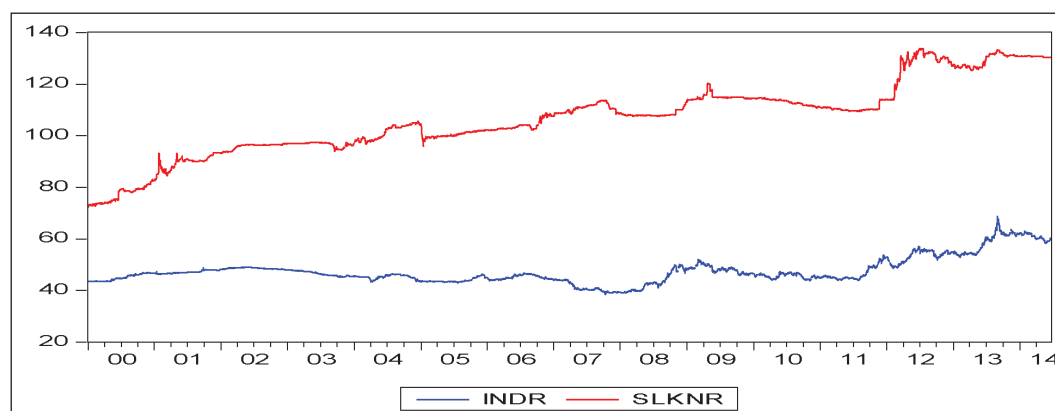


Fig. 2

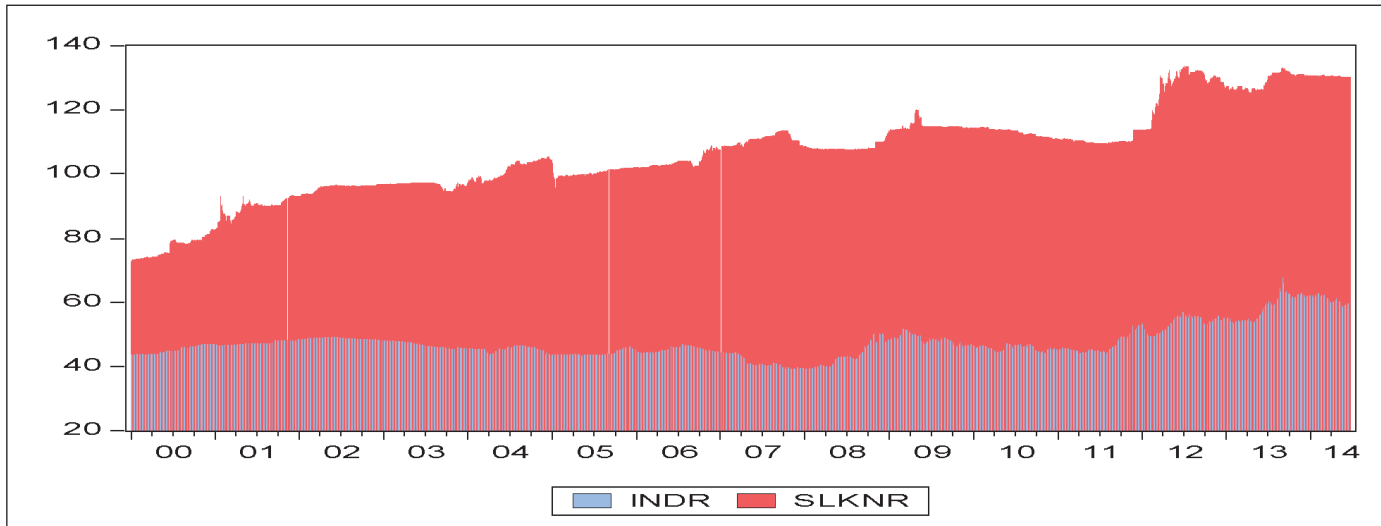
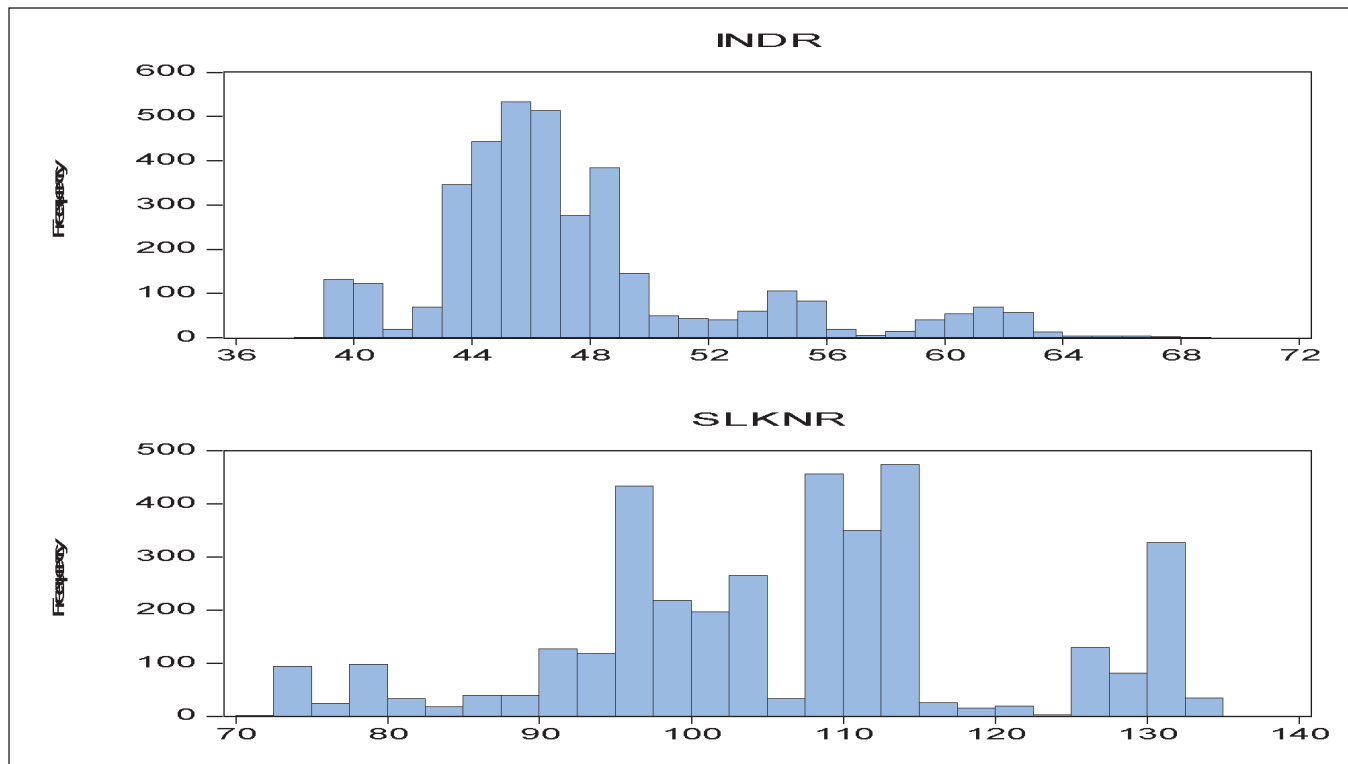


Fig. 3



Augmented Dicky- Fuller Unit Root Test

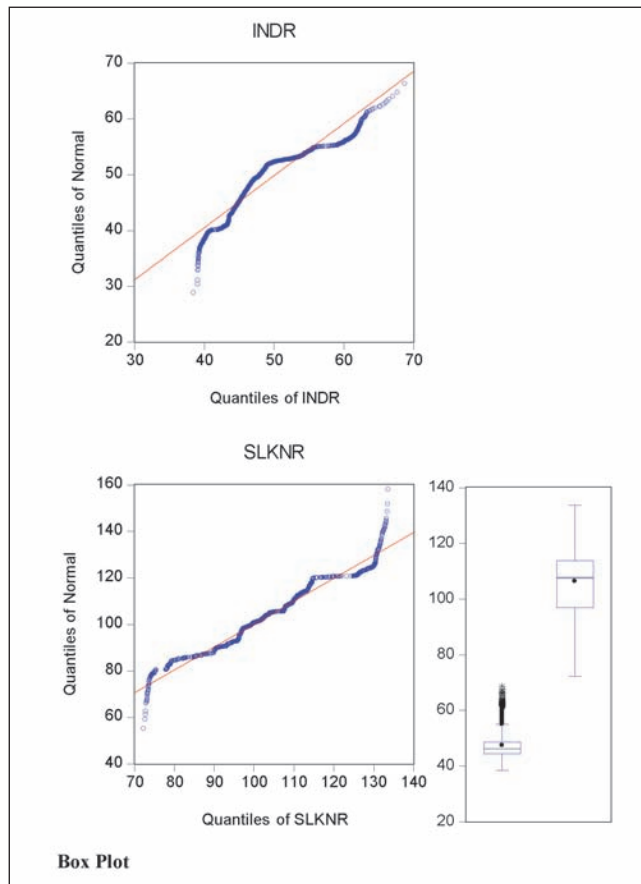
In statistics and econometrics, the Dickey-Fuller test tests whether a unit root is present in an autoregressive model. It is named after the statisticians David Dickey and Wayne Fuller, who developed the test in 1979.

In the present study the unit root test is applied in order to know whether the time series data of both the series is stationary or not.

From Figs. 1 through 4, it has been observed that the time series data of both the series are non-stationary.

The result shows that at the level both the series were non-stationary and they become stationary after taking the first difference. The estimated results of unit root tests for both the series are as under-

Fig. 4



Augmented Dicky-Fuller Unit Root Test on Indian Rupees D(Indr)

Null Hypothesis: D(INDR) has a unit root
 Exogenous: Constant
 Lag Length: 6 (Automatic - based on SIC, maxlag=29)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-17.10822	0.0000
Test critical values:		
1% level	-3.432678	
5% level	-2.862454	
10% level	-2.567302	

*MacKinnon (1996) one-sided p-values.
 Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(INDR,2)
 Method: Least Squares

Date: 07/17/14 Time: 11:20

Sample (adjusted): 1/13/2000 6/20/2014

Included observations: 2594 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INDR(-1))	-0.949670	0.055510	-17.10822	0.0000
D(INDR(-1),2)	-0.095599	0.052021	-1.837693	0.0662
D(INDR(-2),2)	-0.165181	0.048691	-3.392438	0.0007
D(INDR(-3),2)	-0.175194	0.044054	-3.976823	0.0001
D(INDR(-4),2)	-0.145320	0.038893	-3.736409	0.0002
D(INDR(-5),2)	-0.044499	0.031364	-1.418782	0.1561
D(INDR(-6),2)	-0.030547	0.021522	-1.419343	0.1559
C	0.004056	0.004742	0.855350	0.3924

R-squared	0.522738	Mean dependent var	-0.002745
Adjusted R-squared	0.521446	S.D. dependent var	0.348577
S.E. of regression	0.241138	Akaike info criterion	-0.003819
Sum squared resid	150.3689	Schwarz criterion	0.014256
Log likelihood	12.95377	Hannan-Quinn criterion	0.002731
F-statistic	404.6295	Durbin-Watson stat	1.987623
Prob(F-statistic)	0.000000		

Augmented Dicky- Fuller Unit Root Test on SriLankan Rupees D(Slknr)

Null Hypothesis: D(INDR) has a unit root

Exogenous: Constant

Lag Length: 6 (Automatic - based on SIC, maxlag=29)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-17.10822	0.0000
Test critical values:		
1% level	-3.432678	
5% level	-2.862454	
10% level	-2.567302	

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

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(INDR,2)

Method: Least Squares

Date: 07/17/14 Time: 11:20

Sample (adjusted): 1/13/2000 6/20/2014

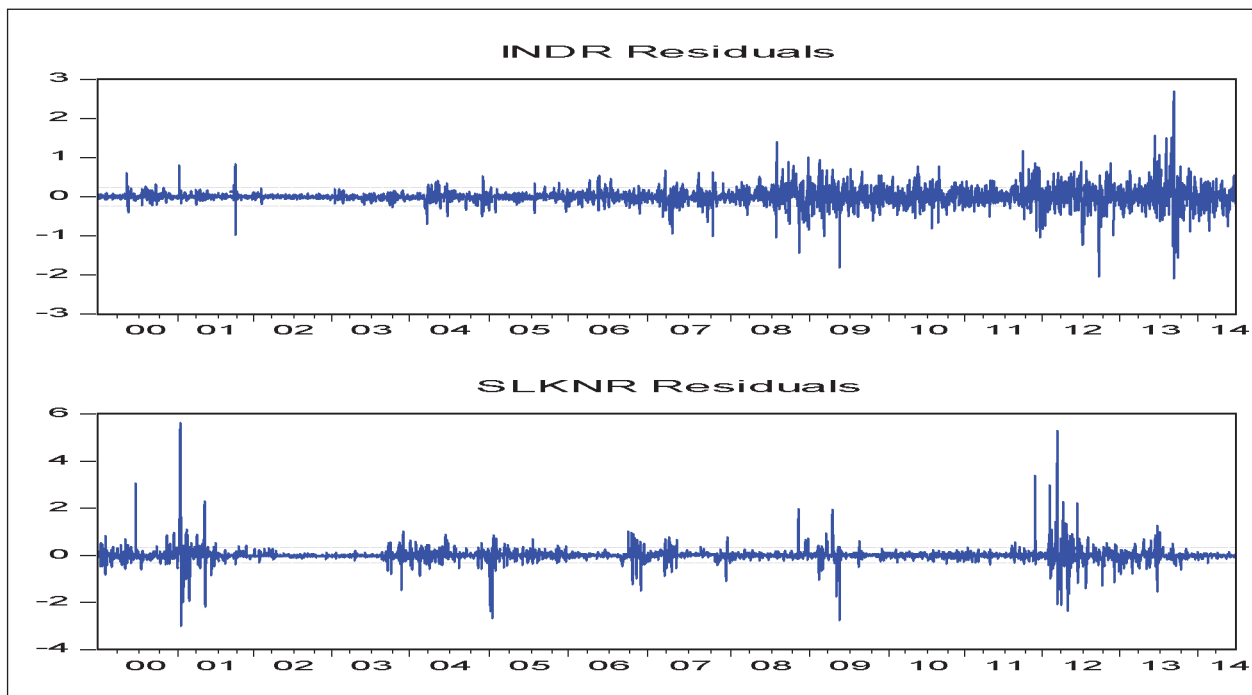
Included observations: 2594 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
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R-squared	0.522738	Mean dependent var	-0.002745	
Adjusted R-squared	0.521446	S.D. dependent var	0.348577	
S.E. of regression	0.241138	Akaike info criterion	-0.003819	
Sum squared resid	150.3689	Schwarz criterion	0.014256	
Log likelihood	12.95377	Hannan-Quinn criterion	0.002731	
F-statistic	404.6295	Durbin-Watson stat	1.987623	
Prob(F-statistic)	0.000000			

VAR (Vector Autoregression) Models

Vector autoregression (VAR) is an econometric model widely used in finance to capture the linear interdependencies among multiple time series data. It generalises the univariate autoregression (AR) models by allowing more than one evolving variable. VAR modeling does not require as much knowledge about the forces influencing a variable as do structural models with simultaneous equations. It requires only a list of variables which can be hypothesised

Fig. 5



to affect each other inter temporally.

The main objectives of a VAR model is to describes the evolution of a set of k variables (called *endogenous variables*) over the same sample period ($t = 1, \dots, T$) as a linear function of only their past values. The variables are collected in a $k \times 1$ vector y_t , which has as the i^{th} element, $y_{i,t}$, the time t observation of the i^{th} variable. For example, if the i^{th} variable is exchange rate, then $y_{i,t}$ is the value of exchange rates at time t .

A p th order VAR, denoted VAR(p), is

$$y_t = c + A_1y_{t-1} + A_2y_{t-2} + \dots + A_p y_{t-p} + e_t$$

where the l -periods back observation y_{t-l} is called the l -th **lag** of y , c is a $k \times 1$ vector of constants (intercepts) A_i is a time-invariant $k \times k$ matrix and e_t is a $k \times 1$ vector of error terms satisfying

$E(e_t) = 0$ — every error term has mean zero;

$E(e_t e_t') = \Omega$ — the contemporaneous covariance matrix of error terms is Ω (a $k \times k$ positive semidefinite matrix) ;

$E(e_t e_{t-k}') = 0$ for any non-zero k — there is no correlation across time; in particular, no serial correlation in individual error terms. A p th-order VAR is also called a VAR with p **lags**. The process of choosing the maximum lag p in the VAR model requires special attention because inference is dependent on correctness of the selected lag order.

In the present study VAR model is estimated to measure the Granger Causal relationship between exchange rates of Indian rupees (indr) and SriLankan rupees(slknr) against the U.S. dollar. The estimated results of the Vector

Autoregression (VAR) model are as follow:

Vector Autoregression Estimates

Date: 07/17/14 Time: 11:38

Sample (adjusted): 1/07/2000 6/20/2014

Included observations: 3086 after adjustments

Standard errors in () & t-statistics in []

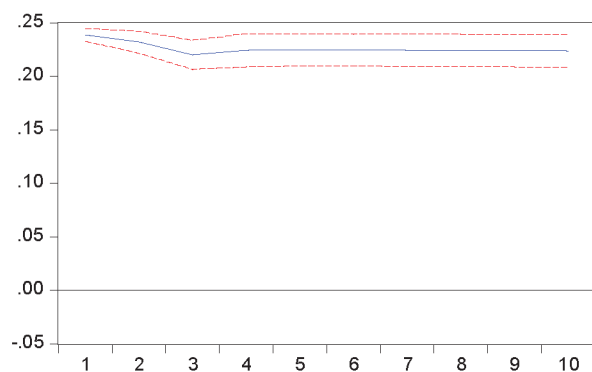
	INDR	SLKNR
INDR(-1)	0.972004 (0.01813) [53.6182]	0.051818 (0.02506) [2.06774]
INDR(-2)	-0.022863 (0.02527) [-0.90486]	0.007402 (0.03493) [0.21192]
INDR(-3)	0.064428 (0.02614) [2.46482]	-0.046211 (0.03613) [-1.27889]
INDR(-4)	-0.014502 (0.01878) [-0.77203]	-0.009971 (0.02597) [-0.38401]
SLKNR(-1)	-0.007485 (0.01321) [-0.56673]	1.091001 (0.01826) [59.7535]
SLKNR(-2)	0.013889 (0.01970) [0.70510]	-0.149124 (0.02723) [-5.47652]
SLKNR(-3)	0.013175 (0.01981)	0.117815 (0.02738)

	INDR	SLKNR
	[0.66519]	[4.30316]
SLKNR(-4)	-0.019494	-0.060953
	(0.01339)	(0.01851)
	[-1.45552]	[-3.29224]
C	0.037468	0.001468
	(0.04144)	(0.05729)
	[0.90415]	[0.02562]
R-squared	0.997848	0.999460
Adj. R-squared	0.997842	0.999458
Sum sq. resids	174.7436	333.9281
S.E. equation	0.238307	0.329430
F-statistic	178329.9	711707.1
Log likelihood	51.58922	-947.6670
Akaike AIC	-0.027602	0.620005
Schwarz SC	-0.010002	0.637604
Mean dependent	47.43033	106.4268
S.D. dependent	5.130199	14.15625
Determinant resid covariance (dof adj.)		0.006127

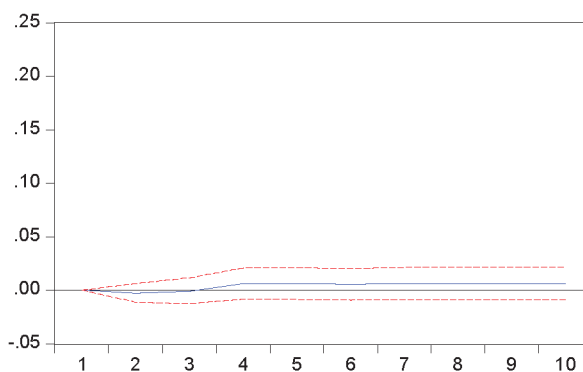
	INDR	SLKNR
Determinant resid covariance		0.006091
Log likelihood		-887.0365
Akaike information criterion		0.586543
Schwarz criterion		0.621742

Impulse Response

In a VAR model an Impulse response generally allows one to trace the time path of the impact of a shock in one variable on all the variables included in it. The standard impulse response analysis assumes that the shock occurs in one variable at a time. Such an assumption may be valid only if the shocks in different variables are not correlated. When there is significant contemporaneous correlation between the series, the results of impulse response analysis depends on method of decomposition used. Cholesky decomposition is one of the popular methods used for this purpose. The estimated VAR model shows the following impulse response graphs-



Response of SLKNR to INDR



Response of SLKNR to SLKNR

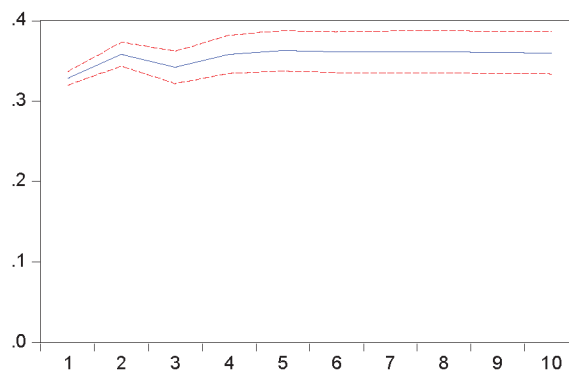
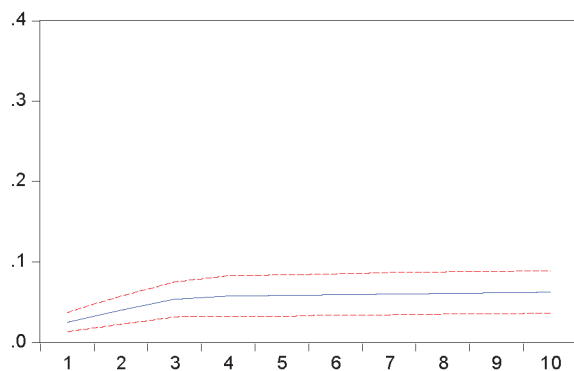


Fig. 6

Granger Causality Test

The Granger causality test is a statistical tool used for determining whether one time series is useful in

forecasting another. Basically, regressions reflect «mere» correlations, but Clive Granger argued that causality in finance could be reflected by measuring the ability of predicting the future values of a time series using

past values of another time series. Since the question of «true causality» is deeply philosophical, econometricians assert that the Granger test finds only «predictive causality».

Granger defined the causality relationship based on two principles:

1. The cause happens prior to its effect.
2. The cause has *unique* information about the future values of its effect.

Given these two assumptions about causality, Granger proposed to test the following hypothesis for identification of causal effect of X on Y :

$$P [Y(t+1) \in A | I(t)] \neq P [Y(t+1) \in A | I_{-X}(t)]$$

where A is an arbitrary non-empty set. The symbols $I(t)$ and $I_{-X}(t)$ denote all the information until time t in the entire universe and the modified universe in which X is excluded, respectively. If the above hypothesis is accepted, we call X Granger causes Y .

The results of pairwise Granger Causality Tests are as under-

Pairwise Granger Causality Tests

Date: 07/17/14 Time: 11:41

Sample: 1/03/2000 6/20/2014

Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
SLKNR does not Granger Cause INDR	3086	0.71661	0.5805
INDR does not Granger Cause SLKNR		3.42787	0.0084

CONCLUSION

The present study empirically examines the Granger casual relationship between currencies exchange rates of Indian and SriLankan rupees against the U.S. Dollar. To begin with, stationarity of time series data of both the series is checked with the help of ADF unit root test and the results showed stationarity at first difference for both the series. Unsurprisingly the results of the study show very little evidence of casual relationship between the exchange rates of two currencies against the U.S. dollar. Since bivariate VAR model has been estimated, two panels are displayed, with one for each dependent variable in the system. Only few results of the study show some causality that is significant. Hence, Granger Causality test was also applied to determine the direction of influence between the two series, which proved unidirectional causality between the two series. The graphs of the impulse response shows that responses to the shocks are very small, except for the response of a variable to its own. All these results are estimated with the help of E. Views software

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