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INTRODUCTION

REVIEW OF LITERATURE

NEED/IMPORTANCE OF THE STUDY

STATEMENT OF THE PROBLEM

OBJECTIVES

HYPOTHESIS (ES)

RESEARCH METHODOLOGY

RESULTS & DISCUSSION

FINDINGS

RECOMMENDATIONS/SUGGESTIONS

CONCLUSIONS

LIMITATIONS

SCOPE FOR FURTHER RESEARCH

REFERENCES

APPENDIX/ANNEXURE

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- Schemenner, R.W., Huber, J.C. and Cook, R.L. (1987), "Geographic Differences and the Location of New Manufacturing Facilities," Journal of Urban Economics, Vol. 21, No. 1, pp. 83-104.

CONFERENCE PAPERS

- Garg, Sambhav (2011): "Business Ethics" Paper presented at the Annual International Conference for the All India Management Association, New Delhi, India, 19–23

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IMPACT OF COVID-19 ON PHYSICAL AND MENTAL HEALTH OF HEALTHCARE WORKERS: A STUDY OF SELECT HOSPITALS IN MANDYA DISTRICT

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ABSTRACT

The most important objective of this paper to collect information of healthcare facilities in Mandya district. Coronavirus disease (COVID-19) pandemic has spread to 198 countries, with approximately 2.4 million showed instances and 47, 36,136 deaths as of September 24 - 2021. Frontline healthcare workers face a significantly higher risk of infection and loss of life due to excessive COVID-19 exposure. This evaluation aimed towards summarizing the evidence of physical and mental health impact of COVID-19 pandemic on healthcare workers. This studies paper focused on health practices, health insurance and remedies. Develop standards, guidelines, and code of practice on health and safety, establish policies to ensure appropriate or flexible working hours and those results in minimizing the executive burden on healthcare workers, Ensure adequate environmental services such as water, sanitation and hygiene, disinfection and adequate air flow in any respect healthcare facilities.

KEYWORDS

COVID-19, sickness, healthcare workers, anxious, physical health, mental health, stress.

JEL CODES

I10, I11, I12.

INTRODUCTION

We all had been suffering from the present day COVID-19 pandemic. However, the effect of the pandemic and its effects are felt in a different way depending on our reputation as people and as individuals of society. COVID-19 is killing human beings on a big scale. Healthcare workers (HCWs), on the heart of the exceptional disaster of COVID-19, decreasing the spread of infection, growing appropriate short-time period plans. HCWs experience emotional exhaustion, which might also additionally cause scientific errors, lack of empathy in treating patients. Here, for HCWs encouraged taking benefit of help structures which includes family and friends to stabilize emotions, percentage experiences, and keeping social connections, accordingly decreasing anxiety intensities and enabling high-satisfactory sleep. Long time period outcomes of the world-wide pandemic continue to be unknown. HCW responses approximately distress and burnouts however urge future studies on techniques to enhance their wellbeing. To continue to provide uninterrupted, high-satisfactory care, the healthcare workforce-human beings-should is empowered and recommended to take care of them.

STATEMENT OF THE PROBLEM

Good health is a valuable to human happiness and wealth being that make contributions extensively to prosperity and wealth or even financial progress, as healthful populace is greater effective, secure greater and stay longer. Healthcare employees like **Nurses, Doctors, ASHA workers, and different clinical group of workers that laboured on frontlines**. There are about fifty-nine million healthcare employees global spotting the important position plaid with the aid of using healthcare specialists as the **"The most valuable belongings for fitness"**.

In Mandya **45%** of adults are said that they may be expensing **anxiety and strain** those wide variety are gently to growth as humans keep to bodily distance themselves in addition to fear approximately getting stick from COVID-19. Longer running time in keeping with week changed into observed to be a danger factor. Masks and different protecting designed and sized for guys depart girls at extra danger of exposure. **COVID-19 pandemic price of burnout is better in female healthcare workers than male workers.** The COVID-19 pandemic has impacted healthcare employees bodily and psychologically. A examine from Mandya confirmed that healthcare workers being concerned for sufferers with COVID-19 said tension, despair and strain. Healthcare specialists said being hectic approximately having to self-isolate, quarantine or becoming.

Healthcare workers laboured at the frontlines in Mandya skilled signs of **tension, despair and issue sleeping, insomnia, mental distress, unknowingly unfold of the ailment among their sufferers and their families, scarcity of resources, Livy escapes sanitizing the hospitals, loss of Government policies and regulation, mentally weakness.**

REVIEW OF LITERATURE

➢ **M D Braquehais, M Casas and S Vaero – 2020**, explain the high prevalence of anxiety and depressive symptoms among health workers, COVID-19 exposure, epidemiological issue, material resources, human and personal factor, the influence of individual and social narratives in healthcare workers, and its factors are associated with a higher risk of developing long lasting negative effects.

➢ **Carmen Moreno, Marco Solmi and Ana Catalan – 2020**, concluded that the healthcare workers are at high risk of developing physical and mental outcome related to syndromes, they also say that MOOSE- compliant systematic review of web of science literature to identify studies, and they stated that healthcare workers infected to serve acute respiratory syndrome –SARS, middle east respiratory syndrome – MERS and mainly substantial impact on the physical and mental health of healthcare workers.

➢ **Athanasis J Manolis, Triantafyllies – 2020**, revealed that the unprecedented public health crisis of the COVID-19 pandemic, the psychological impact of this mounting threat on healthcare professionals and explain the effect of previous epidemics on frontline healthcare staff.

➢ **Marayam Vizheh, Mostafa Qorabani – 2020,** said that the Coronavirus is widely spreading the entire world, causing mental health problems for most of healthcare workers, it carried out on the mental health stress of healthcare workers, the lowest reported prevalence of anxiety, depression, and stress among healthcare workers, and healthcare workers faced aggravated psychological pressure and even mental illness. And mainly they said to policymakers and managers to adopt the supportive, encouragement and motivation and training and education to frontline workers, especially communication platform.

➢ **Nina Vindegaard, Michael Eriksen Benros – 2020**, defined that the indirect effect of the pandemic on general mental health are of increasing concern, and it including the measuring psychiatric symptoms or morbidities associated with COVID-19 infected and non-infected group the latter divided in psychiatric patients and healthcare workers and non-healthcare workers.

SCOPE OF THE STUDY

The study covers 20 Doctors, 20 Nurses, 30 ASHA workers and 30 other staff, based in Malavalli taluk, Maddur taluk in Mandya district.

OBJECTIVES OF THE STUDY

1.   To examine the challenges faced by healthcare workers during COVID-19.
2.   To study physical and psychological impact on health care workers during pandemic.
3.   To find out the various factors effect on mental and physical health conditions.
4.   To suggest to improve mental health overall physical health based on the study.

RESEARCH METHODOLOGY

The study is to be conducted using empirical type of study and to know the issue and challenges faced by healthcare workers or professionals during pandemic. This study depends on both primary and secondary data.

SAMPLING PLAN

SAMPLING UNIT: 10 hospitals in Mandya District

SAMPLING SIZE: 100 respondents.

SAMPLING PROCEDURE: Stratified sampling, and convenience sampling.

TABLE 1

Sl. No	Division	Hospitals		No. of respondents (100)	
		Private hospital	Government hospital	Private hospital	Government hospital
1.	Maddur Taluk	JSS hospital	Gurushanthappa Govt. hospital	8	10
		Maddur Medical Centre	Primary health care centre	5	15
		Surakshan nursing home	Taluk Govt. hospital	3	32
2.	Malavalli Taluk	Mandara Maternity	Government hospital	2	8
		Vikram hospital	Taluk Govt. hospital	4	13
Total				22	78

TOOLS FOR DATA COLLECTION

The data collected using questionnaires includes personal profile, the research classification, the collected raw data and put code to transfer team into master sheet. The data tabulation into simple table after coding analysis and interpreted.

SOURCES OF DATA

The data was collected through the primary and secondary data.

Primary data: It is collected through investigation and questionnaires and observation by using face to face enquiry method.

Secondary data: These are those data which are obtained indirectly from sources such as books, journals, articles, newspaper and websites of healthcare services or online service etc.

ANALYSIS

PROFILE OF THE RESPONDENTS

TABLE 1: DEMOGRAPHIC FACTORS OF RESPONDENTS

Profile variables	Particulars	No. of Respondents	Percentage (%)
Gender	Male	34	34%
	Female	**66**	**66%**
Age	18-25	13	13%
	25-35	**54**	**54%**
	35-45	29	29%
	Above 45	4	4%
Marital status	Married	**80**	**80%**
	Un married	20	20%
Educational Qualification	7th – 10th standard	20	20%
	P U C	27	27%
	Graduated- Diploma	**40**	**40%**
	Post- Graduated	12	12%
	Other	1	1%
Occupation	Doctor	20	20%
	Nurse	20	20%
	ASHA workers	30	30%
	Other staffs	30	30%
Category of hospital	Government hospital	**78**	**78%**
	Private hospital	22	22%

(Source: Primary data)

The Demographic factors of respondents shows 66% of females, the age of 25 to 35 respondents as occupied 54%, there are 80% married respondents, 40% of respondents are based up on graduate and diploma, 30% ASHA workers are there, 78% of respondents categorized in Government hospital.

TABLE 2: HOW THEIR FAMILY, FRIENDS AND OTHERS CAN SUPPORT DURING THE COVID-19 OUTBREAK?

PARTICULAR	NO. OF RESPONDENTS	PERCENTAGE
Supported	84	84%
Not supported	9	9%
May be	7	7%
Total	**100**	**100%**

(Source: Primary data)

The more 84% respondents' families are supported during the pandemic, 9% respondent's families are not supported and 7% respondent's families found difficult to support. It is explained that 84% respondent's families are supported.

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TABLE 3: HOW THE RESPONDENTS EXPERIENCE THEIR WORK WITH SICKNESS SINCE LAST 6 MONTHS

PARTICULAR	NO. OF RESPONDENCE	PERCENTAGES
Highly bothered	45	45%
Low bothered	31	31%
Neutral	7	7%
No not at all	17	17%
Total	**100**	**100%**

(Source: Primary data)

The more 45% respondents are highly bothered in sickness from last 6 months, 31% respondents are low bothered in sickness, 7% respondents are neutral and 17% respondents are not bothered in sickness. It clearly those 45% respondents are highly bothered in sickness.

TABLE 4: MENTAL HEALTH OF RESPONDENTS AFFECTED YOUR RELATIONSHIP

PARTICULAR	Very often	often	Not so often	Not at all	Total
NO. OF RESPONDENTS	11	50	13	26	**100**
PERCENTAGE	11%	50%	13%	26%	**100%**

(Source: Primary data)

The result of more 50% of respondents often their mental health affected their relationship, 11% of respondents are said very often, and some 13% and 26% respondents not at all affected their relationship. It is conveying that 50% respondents often their mental health affected their relationship.

TABLE 5: DURING COVID-19 PANDEMIC HAD ANY PROBLEMS WITH THE WORK OF RESPONDENTS DUE TO THEIR PHYSICAL HEALTH

PARTICULAR	Yes	No	Not at all	Total
NO. OF RESPONDENTS	68	27	5	**100**
PERCENTAGE	68%	27%	5%	**100%**

(Source: Primary data)

The result that they faced any problems with their work or daily life due to their physical health more 68% had chosen yes, 27% chosen no, and few of them chosen not at all.

TABLE 6: WHETHER RESPONDENTS OFFERED ANY ADDITIONAL COMPENSATION OR BENEFITS DURING THE COVID-19 PANDEMIC

PARTICULAR	NO. OF RESPONDENTS	PERCENTAGE
Yes	23	23%
No	76	76%
May be	1	1%
Total	**100**	**100%**

(Source: Primary data)

The result of their facility offered additional compensation or benefits in that more 76% chosen no because they are not getting any benefits some of them chose 23% yes and only one respondent chosen may be.

TABLE 7: HEALTHCARE WORKERS SLEEPING HOURS DURING PANDEMIC

PARTICULAR	4 hours	4-6 hours	7-8 hours	9 hours	Total
NO. OF RESPONDENTS	1	43	56	0	**100**
PERCENTAGE	1%	43%	56%	0	**100%**

(Source: Primary data)

The more 56% are chosen those 7-8 hours because no changes in routine, 43% are chosen those 4-6 hours because this is answered by ASHA workers, only 1% is chosen 4 hours to sleep.

TABLE 8: SHOWS THAT THE HEALTHCARE WORKERS RECEIVE HEALTH AND SAFETY TRAINING

PARTICULAR	Agree	Strongly agree	Neutral	Disagree	Strongly disagree	Total
NO. OF RESPONDENTS	60	33	4	3	0	**100**
PERCENTAGE	60%	33%	4%	3%	0%	**100%**

(Source: Primary data)

The More 60% of respondents are agreeing to receive health and safety training. 33% respondents are strongly agreed to safety training, 4% respondents are neutral, 3% respondents are disagreeing and no respondent for strongly disagree.

TABLE 9: RESPONDENTS DIFFICULTY TO ADJUST TO THE NEW ROUTINE DURING THE LOCKDOWN PERIOD

PARTICULAR	NO. OF RESPONDENTS	PERCENTAGE
Yes	58	58%
No	28	28%
May be	14	14%
Total	**100**	**100%**

(Source: Primary data)

The More 58% said yes because they have adjusting nature, and 28% said no because they found difficult, and 14% said may be because they are in doubt.

TABLE 10: PROBLEMS FACED WHEN THEY WERE WEARING THE PPE KITS

PARTICULAR	Irritation	Skin reaction	Breathing problems	Uncomfortable feel	All of the above	Total
NO. OF RESPONDENTS	11	1	7	10	71	**100**
PERCENTAGE	11%	1%	7%	10%	71%	**100%**

(Source: Primary data)

Table 10 showing, more 71% of respondents said all of the above because they felt irritation, skin reaction, breathing problems, and uncomfortable because the PPE kits are plastic

LIMITATIONS OF THE STUDY
1. The study was restricted to only physical and mental health impact of the COVID-19 on health workers in Mandya district hospitals.
2. The study confines Mandya District only.
3. Sample size of the respondents was limited to 100.
4. The problem of getting the respondents for the interview as it awes the production period.

FINDINGS

1. It is clear about majority of 45% respondents are faced highly suffered from sickness.
2. The highest respondents are faced problem when wearing the PPE kits.
3. The highest respondents are sleeping only 4-6 hours in a day.
4. More number of respondents is faced physical health problem due to their work.
5. The result shows that majority respondents are not received any additional compensation or benefits.
6. The more respondents are said their mental health affected their relationship.
7. The majority respondents are receiving or taken health and safety training.

SUGGESTIONS

1. They required more training and programme for reducing of physical and mental stress, Adequate counselling and Separate training for females workers
2. Healthcare workers need to acquire their month salary in time and the event that they get few intensives it will likely be useful for them especially for ASHA workers and Nurses.
3. Provide coverage insurance for work-associated threat, specifically the ones operating in high-risk areas.
4. Ensure availability of private protecting equipment (PPE) in any respect times, as applicable to the position and duties achieved in adequate, in great and suitable match and of applicable great. Ensure adequate training on the correct use of PPE and protection precaution.
5. Both Government and public companies have to create more awareness about health insurance coverage.
6. The family support required to overcome both physical and mental stress in work place like hospital.

CONCLUSION

In summary our study is an important addition to the growing body of literature that sheds light on the growing mental health and physical health crisis amongst doctors, nurse and ASHA workers in Mandya district. This study suggests that the psychological wellbeing and mental health should be carefully monitored during the pandemic, and hospital and workplace should provide psychological support for these circumstances through targeted intervention. This attempt may need to be mainly focused on doctors, female workers and nurses, as it was found that these people reported higher stress, anxiety, and depression. A comprehensive and proactive strategy of providing mental health services at point of case on the entire healthcare workforce should be a key focus of all healthcare institutions and adequate resources should be invested in this direction.

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DECADAL TRACKING OF FOREIGN EXCHANGE RATES: AN APPLICATION OF COINTEGRATION

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ABSTRACT

This paper reveals decadal foreign exchange cointegration (from beginning of July 2008 and ending June 2018) among US dollar, Great Britain Pound, Euro, and Japanese Yen with respect to Indian rupees. The cointegration tool has been used to study the relationship. The two methods of testing for cointegration are: Engle-Granger tests and Johansen-Juselius tests have been applied. When the variables are cointegrated, the estimates of the long-run equilibrium parameters are consistent and highly efficient. A decadal rupees/USD, rupees/GBP, a decadal rupees /USD, rupees/Euro, a decadal rupees /USD, rupees/yen, a decadal rupees /GBP, rupees/Euro, a decadal rupees /GBP, rupees/yen, a decadal rupees /euro, rupees/yen nexus, have been unearthed.

KEYWORD
Foreign exchange.

JEL CODE
F31

1. INTRODUCTION

Decadal tracking of foreign exchange rates: an application of cointegration is the study of foreign exchange rates namely four major foreign exchanges with respect to rupees that is US dollar, Great Britain Pound, EURO, and Japanese Yen on ten year time horizon, from beginning of July 2008 and ending June 2018. The need for study arises from following literatures that say foreign exchange market is very dynamic. Lasko Basnarkov, Viktor Stojkoski, Zoran Utkovsk, and Ljupco Kocarev (2020) studies the relationships between one-minute log returns on exchange rates.

The existence of statistically significant lagged correlations shows that, even though, the foreign exchange market is known to have very fast dynamics, information spreading is not instantaneous. They have discovered that the rates, which cause others to follow their dynamics, are mostly those that involve stock market indexes. Observing changes in the value of an index implies that certain currencies, or market indexes would more likely gain, while others would lose value. This was further confirmed by the calculation of the lagged partial correlation between the leader and the lagger exchange rate.

The above needs for study put forth immediate study of as for mentioned objectives.

OBJECTIVES OF THE STUDY

1. To unearth the cointegration among foreign exchange rate viz. US dollar, Great Britain Pound, EURO and Japanese Yen.
2. To analyse the cointegration between the US dollar and the Great Britain Pound.
3. To analyse the cointegration between US dollar and EURO.
4. To show the nexus between rupees/USD and rupees/yen.
5. To analyse the cointegration between rupees /GBP and rupees/EURO.
6. To unearth the cointegration between rupees/GBP and rupees/Yen.
7. To analyse the cointegration between rupees /EURO and rupees/Yen.

The evaluation of above-mentioned objectives descriptive research as well as empirical research has been used. The brief introduction of methodology is described here and detail of methodology used for research has been described in the methodology section of this paper.

RESEARCH METHODOLOGY

Data and sample: the four major foreign exchanges with respect to rupees: US dollar, Great Britain Pound, EURO, and Japanese Yen, over the period beginning July 2008 and ending June 2018 has been used. The sample consists of 2,409 observations. The descriptive statistics like minimum, first quartile, median, mean, third quartile, maximum, range and standard deviation are depicted in the Summary statistics table of all four foreign exchanges.

Stationary and nonstationary test and Cointegration: Cointegration test has been done after the order of integration of the foreign exchange rate is determined. Tests for unit roots are performed using the augmented Dickey-Fuller (ADF) tests. When the variables are cointegrated, the estimates of the long-run equilibrium parameters are consistent and highly efficient. Two methods of testing for cointegration are: Engle-Granger tests and Johansen-Juselius tests.

2. REVIEW OF LITERATURE AND HYPOTHESIS

Bing Li, Zefang Liao in "Finding changes in the foreign exchange market from the perspective of currency network" attempts to find changes in the foreign exchange market by focusing on the time horizon from January 2006 to December 2012, covering the pre and post periods of the 2008 global financial crisis.

The topological properties of the currency network in the pre- and post-crisis periods are studied and compared. The geographic and market classification are also used to test linking tendency between currencies. They construct the correlation-based networks in 2006-2007 and 2011-2012, corresponding to the pre- and post-crisis period separately.

Boudt, K., Neely, C. J., Sercu, P., & Wauters, M. (2019). Analyzed "The response of multinationals' foreign exchange rate exposure to macroeconomic news".

The intra-day estimate of daily foreign exchange exposure coefficients have co-varied with the value of the dollar at low frequencies and with news at high frequencies. Macroeconomic announcements affect foreign exchange exposure of U.S. multinational firms in a statistically and economically significant way.

Adler, G., Lisack, N., & Mano, R. (2019), in "Unveiling the effects of foreign exchange intervention (FXI): A panel approach" aimed to understand the relevance of FXI as a macroeconomic policy tool, that is, going beyond the intra-day or daily effects.

Yamani, E. (2020), in "Foreign Exchange Market Efficiency and the Global Financial Crisis: Fundamental (FUH) versus Technical Information" reported the comparative analysis of the FUH and technical trading rules reveals that the two hypotheses predict opposite conclusions on the direction of the change in the state of market performance in the crisis period. While the FUH results give some evidence that the forward puzzle is less prominent during the crisis period, simple technical trading rules react the opposite way in response to a volatility rise during the crisis period by showing that Foreign Exchange (FX) markets are profitable during the crisis period.

Choi, J. H. (2019), in "Capital Controls and Foreign Exchange Market Intervention" He considered the trade-off between capital controls and foreign exchange intervention. The model was constructed under the assumption that rational policymakers understand the trajectories of shadow exchange rates under different regimes and decide how much to float or peg by simply making series of regime choices. The current model assumes that the foreign exchange intervention decision is not constrained by the level of international reserves to simplify the dynamics of solutions.

Adler, G., Lama, R., & Medina, J. P. (2019) "Foreign Exchange Intervention and Inflation Targeting: The Role of Credibility" they find two key results, first, in a baseline scenario where the central bank is perfectly credible, FXI can improve macroeconomic outcomes by successfully stabilizing both output and inflation in response to foreign disturbances. Second, when central bank lacks credibility, FXI policies entail a trade-off by reducing output volatility at the expense of inducing higher inflation volatility.

Andrikopoulos, A., Wang, C., & Zheng, M. (2019) "Is there still a weather anomaly? An investigation of stock and foreign exchange markets" Behavioral finance holds that security market prices are determined not only by their intrinsic values but also by investor psychology. Weather can affect investors' moods and thus their behavior in financial markets. The weather variables used for New York and London has no apparent impact on the stock and FX markets during 2002–2018. As the economy is globalizing and investors increasingly dispersed, it is increasingly difficult to find significant relationships between weather and financial markets.

THE NULL HYPOTHESES OF THE STUDY

H_O 1. There is no cointegration among four foreign exchanges.

H_O 2. There is no cointegration between the US dollar and the Great Britain Pound. H_O 3. There is no cointegration between US dollar and EURO.

H_O 4. There is no cointegration between rupees/USD and rupees/Yen.

H_O 5. There is no cointegration between rupees /GBP and rupees/EURO.

H_O 6. There is no cointegration between rupees/GBP and rupees/Yen.

H_O 7. There is no cointegration between rupees/euro and rupees/Yen.

3.   RESEARCH METHODOLOGY & ANALYSIS OF THE STUDY

COINTEGRATION

Consider two variables U and G is in single equation. An equilibrium or long-run relationship will be unique if it exists. Assume that theory suggests a long-run relationship described by equation (1) That is: $U_t = bG_t$ … (1). For Ut and Gt to be cointegrated it is required that: (a) the two series should be integrated to the same order; (b) a linear combination of the two series should exist which is integrated to a lower order than the individual series. Consider (a) in the form of the regression model: $U_t = bG_t + \varepsilon_t$.. (2). Where $\varepsilon_t \sim IN(0, \sigma^2)$ and so $\varepsilon_t \sim I(0)$. Then, if Ut and Gt are integrated to different orders, there will not be any parameter b that satisfies (2). Thus, a meaningful long-run relationship implies requirement (1).

Secondly, consider the case where Ut and Gt are both I(1), and the linear combination (Ut- bGt) is I(0). (Ut - bGt) is I(0), then an error correction representation of the form: $\Delta U_t = \alpha \Delta G_t + \lambda(U - bG)_{t-1} + v_t$.. (3). Equation (1) leads to estimates of the parameter(s) of the equilibrium relationship postulated to exist, whilst an estimate of (3) informs us of the magnitudes of the dynamic adjustment coefficients, α and λ. Moreover, (3) possesses all of the well-known advantages of the error correction model.

When the variables are cointegrated, the estimates of the long-run equilibrium parameters are consistent and highly efficient. This consistency property does not require the absence of correlation between the right-hand-side variables and the error term, unlike consistency results in the usual classical regression-model context. The estimators of the short-run parameters are not only consistent, but are as efficient asymptotically as those that would be obtained if the true (rather than estimated) value of the cointegrating vector were known and used in the second stage.

Two methods of testing for cointegration are:

1.   Engle-Granger tests
2.   Johansen-Juselius tests

1. ENGLE-GRANGER COINTEGRATION TESTS

It is developed by Engle and Granger (1987), and is four step process:

Step 1: Test for stationary of underling time series variables. Two methods are informal and formal methods. Informal methods are by examination of a graph and the autocorrelation function of the series for various lags. For non-stationary variables, the lag one-autocorrelation coefficient should be very close to one and decay slowly as the lag length increases.

The formal methods are by employing the Dickey-Fuller statistic and the Augmented Dickey-Fuller statistic. These statistics test the hypothesis that the variables have a unit root, against the alternative that they do not. If it is determined that the variable is non-stationary and the differenced variable is stationary, proceed to step 2

Step 2: Estimation of regression: $U_t = c + d G_t + z_t$. Ut represents U.S. dollar, Gt GBP, and zt the error term; c and d are regression parameters. The null hypothesis states that there is no cointegration and the alternative claims that they are cointegrated.

Step 3: The Dickey-Fuller test. Cointegration test, test for stationarity in zt. Consider the following autoregression of the error term: $\Delta z_t = p z_{t-1} + u_t$. Where zt is the estimated residual. The test focuses on the significance of the estimated p. If the estimate of p is statistically negative, we conclude that the residuals, zt, are stationary and reject the hypothesis of no cointegration.

The residuals of equation $\Delta z_t = p z_{t-1} + u_t$ should be checked to ensure they are white noise. If they are not, we should employ the augmented Dickey-Fuller test (ADF). The augmented Dickey-Fuller test is analogous to the Dickey-Fuller test but includes additional lags of Δz_t. The ADF test for stationarity, like the Dickey Fuller test, tests the hypothesis of p = 0 against the alternative hypothesis of p < 0 for the equation: $\Delta z_t = p z_{t-1} + a1 \Delta z_{t-1} + \cdots + an \Delta z_{t-n} + u_t$.

In Rstudio, The two-step Engle Granger procedure searches for parameters α, β, and ρ that yield the best fit to the following model:

$Y[i] = \alpha + \beta * X[i] + R[i] \quad R[i] = \rho * R[i-1] + [i] \quad [i] \sim N(0, \sigma2)$.

In the first step, alpha and beta are found using a linear fit of X[i] with respect to Y[i]. The residual sequence R[i] is then determined. Then, in the second step, ρ is determined, again using a linear fit. Engle and Granger showed that if X and Y are cointegrated, then this procedure will yield consistent estimates of the parameters.

2. JOHANSEN-JUSELIUS COINTEGRATION TESTS

The Engle-Granger method does have some problems in a multivariate (three or more variables) context. As the sample size approaches infinity, Engle and Granger (1987) showed that the cointegration tests produce the same results irrespective of what variable you use as the dependent variable. A second problem is that the errors we use to test for cointegration are only estimates and the not the true errors. Finally, the Engle-Granger procedure is unable to detect multiple cointegrating relationships.

Consider the following multivariate model: $y_t = Ay_{t-1} + u_t$. Where yt is an n × 1 vector (y1t, y2t,...... ynt)'. ut is an n-dimensional error term at t. A is an n × n matrix of coefficients.

DATA AND SAMPLE

The study concentrates on the four major foreign exchanges with respect to rupees: US dollar, Great Britain Pound, EURO, and Japanese Yen. Daily closing data for all four exchanges has been collected over the period beginning July 2008 and ending June 2018.

The sample consists of 2,409 observations. On national holidays, bank holidays or severe weather conditions, the exchange level was assumed to remain the same as that on the previous trading day. In table 1, initial and last six rows of data have been presented.

In Table 1, shows the summary statistics of different foreign exchanges rates, USD, GBP, EURO, and YEN.

TABLE 1: INITIAL AND LAST SIX ROWS OF DATA

Date USD. GBP. EURO. YEN.	Date USD. GBP. EURO. YEN.
Initial six rows	Last six rows
01/07/2008 43.3 86.3 68.2 41.0	22/06/2018 67.8 90.0 78.9 61.6
02/07/2008 43.3 86.5 68.5 40.9	25/06/2018 68.2 90.3 79.4 62.3
03/07/2008 43.3 86.1 68.7 40.8	26/06/2018 68.2 90.5 79.7 62.2
04/07/2008 43.2 85.7 67.9 40.4	27/06/2018 68.5 90.6 79.9 62.4
07/07/2008 43.1 85.1 67.4 40.2	28/06/2018 68.9 90.2 79.6 62.5
08/07/2008 43.4 85.5 68.1 40.6	29/06/2018 68.6 89.9 79.8 62.0

On 29th June 2018 USD had been 68.6 that risen from 43.3 on 1st July 2008, similarly GBP grown 89.9 from 86.3, EURO rose 79.8 from 68.2 and YEN risen to 62 from 41 in the respective period.

SUMMARY STATISTICS

In the table 2 given below the Summary statistics of all four foreign exchanges rates has been elucidated on minimum (Min), first quartile (1st Qu.), median, mean, third quartile (3rd Qu.), maximum (Max.), range and standard deviation (SD).

TABLE 2: SUMMARY STATISTICS OF ALL FOUR FOREIGN EXCHANGES RATES

Statistics	USD	GBP	EURO	YEN	Statistics	USD	GBP	EURO	YEN
Min.	41.89	65.65	56.07	38.15	3rd Qu.	64.36	95.22	75.81	61.15
1st Qu.	48.17	76.75	66.16	53.1	Max.	68.94	106.03	91.47	72.12
Median	58.91	85.13	70.67	57.4	Range	27.05	40.38	35.4	33.97
Mean	56.63	85.65	71.19	57.38	SD	8.362	10.379	6.848	6.036

FIGURE 1

Figure 1, depicts exchange rate of rupees per unit US dollar over the period of 1st July 2008 to 30th June 2018.

FIGURE 2

Figure 2, depicts exchange rate of rupees per unit GBP over the period of 1st July 2008 to 30th June 2018.

FIGURE 3

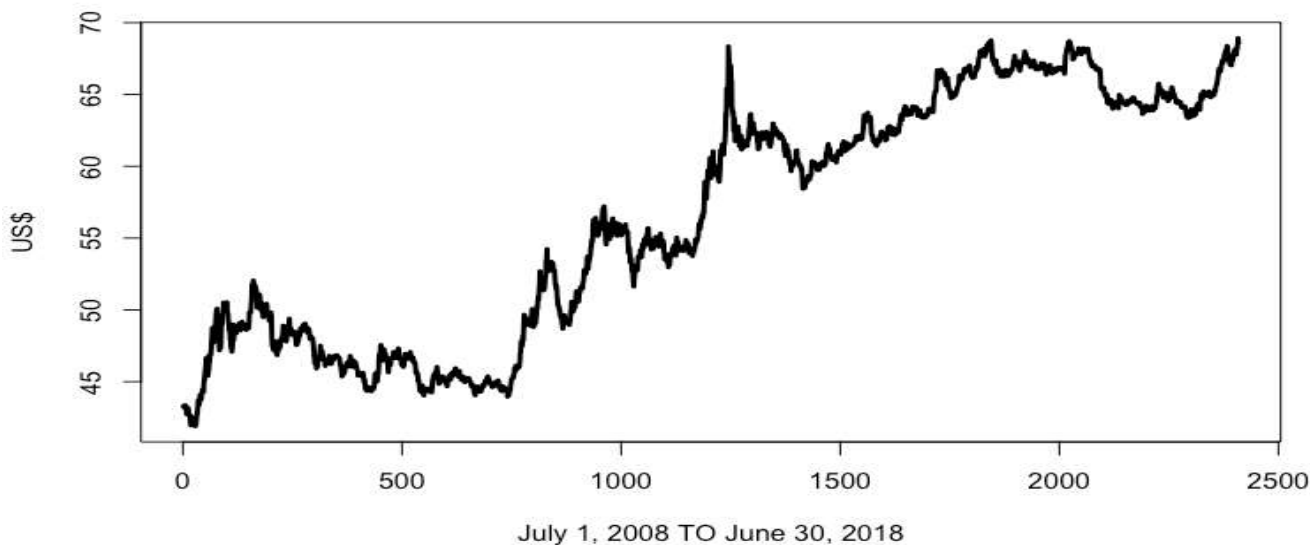Exchange rate Rupees/EURO vs. Time

July 1, 2008 TO June 30, 2018

Figure 3, depicts exchange rate of rupees per unit EURO over the period of 1st July 2008 to 30th June 2018.
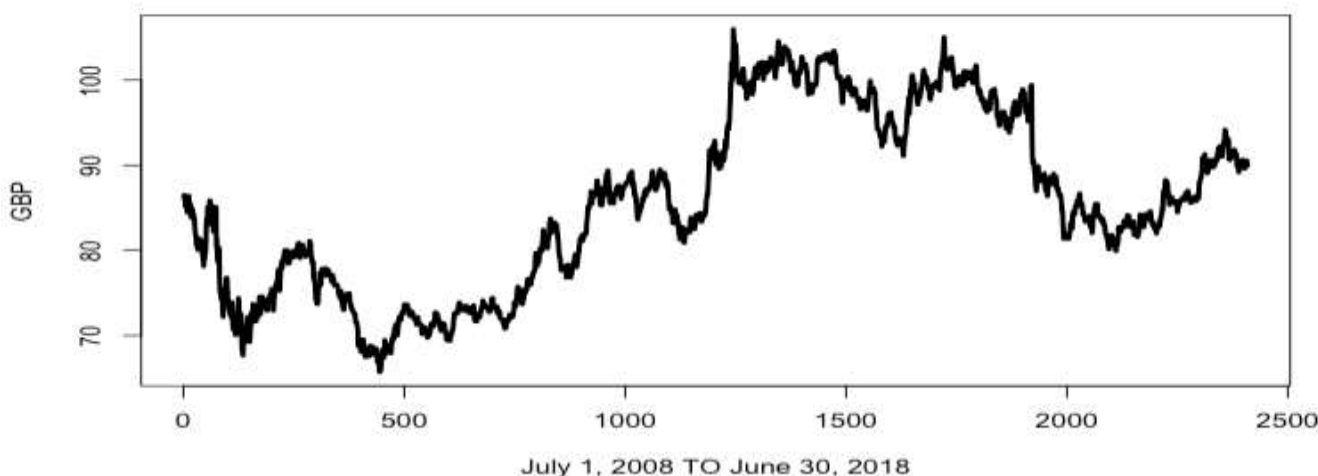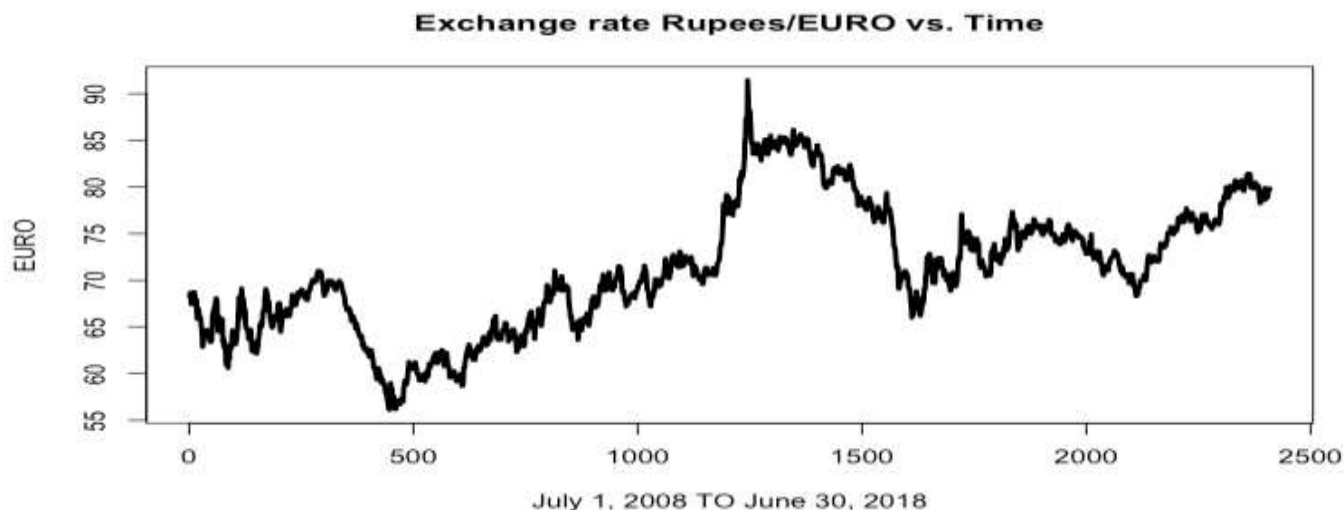
FIGURE 4

Exchange rate Rupees/YEN vs. Time
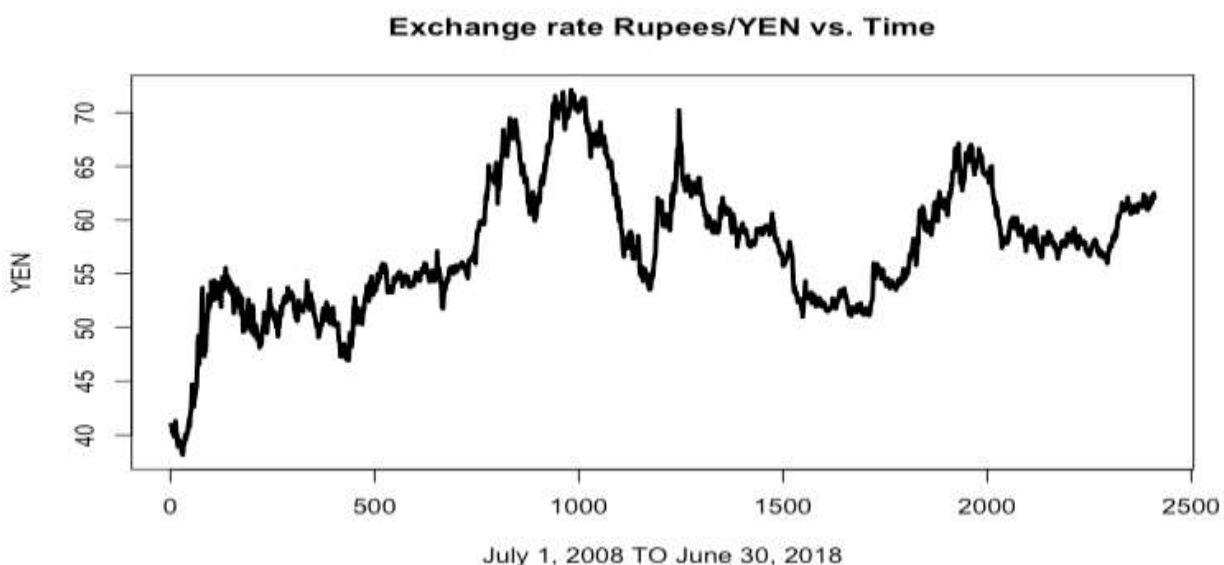
July 1, 2008 TO June 30, 2018

Figure 4, depicts exchange rate of rupees per unit Japanese Yen over the period of 1st July 2008 to 30th June 2018.

STATIONARY AND NONSTATIONARY TEST

Cointegration test has been done after the order of integration of the foreign exchange rate is determined. Tests for unit roots are performed using the augmented Dickey-Fuller (ADF) tests. The null hypothesis is that the foreign exchange rates have a unit root, against the alternative that they do not. The results of the unit root tests based on local currency units i.e. rupees are presented in table 3. Column 1 reports four foreign exchange, column 2 reports augmented Dickey-fuller statistics (ADF tests) for the entire period, column 3 presents lag order, column forth presents p-value and last column reports alternative hypothesis.

The reported results indicate the presence of a unit root in the lag order 13 of all foreign exchange (i.e., the null hypothesis cannot be rejected). However, there is no evidence to support the presence of a unit root in first differences of the foreign exchange. The null hypothesis of a unit root in first differences is rejected for all foreign exchange series. These results are broadly consistent with the hypothesis that the foreign exchange series are individually integrated of order one, I(13).

TABLE 3: UNIT ROOT TEST STATISTICS IN FOREIGN EXCHANGE RATE: JULY I, 2008 & JUNE 1, 2018

Foreign exchange	Dickey-fuller	Lag order	P-value	Alternative hypothesis
USD	-2.4429	13	0.3908	Stationary
GBP	-1.9405	13	0.6035	Stationary
EURO	-2.1876	13	0.4989	Stationary
YEN	-2.9225	13	0.1878	Stationary

The ADF test (augmented Dickey-Fuller test) is based on following regression:

$$Dx_t = a_0 + a_1 x_{t-1} + \sum_{j=1}^{m} b_j Dx_{t-j} + v_t,$$

Where b_j, equals zero for the DF tests, x_t, denotes the foreign exchange rate and v_t, the error term.

4. EMPIRICAL RESULTS

I. A DECADAL RUPEES/USD, RUPEES/GBP NEXUS

$Y[i] = 0.9547 X[i] + 31.5773 + R[i]$, $R[i] = 0.9988 R[i-1] + eps[i]$, $eps \sim N(0, 0.5389^2)$. (0.0162) (0.9638) (0.0017)

$R[2409] = -7.1231$ (t = -1.074). X and Y do not appear to be cointegrated.

The first line of the output shows the fit that was found. The parameters were determined to be $\beta = 0.9547$, $\alpha = 31.5773$ and $\rho = 0.9988$. The standard deviation of the sequence was found to be 0.5389.

Unit Root Tests of Residuals

	Statistic	p-value
Augmented Dickey Fuller (ADF)	-2.251	0.40181
Phillips-Perron (PP)	-9.237	0.43126
Johansen's Trace Test (JOT)	-11.930	0.46601

II. A DECADAL RUPEES /USD, RUPEES/EURO NEXUS

$Y[i] = 0.6155 X[i] + 36.3399 + R[i]$, $R[i] = 0.9980 R[i-1] + eps[i]$, $eps \sim N(0, 0.4257^2)$
(0.0110)   (0.6653)   (0.0019)

$R[2409] = 1.3023$ (t = 0.288). X and Y do not appear to be cointegrated.

Unit Root Tests of Residuals

	Statistic	p-value
Augmented Dickey Fuller (ADF)	-2.324	0.36780
Phillips-Perron (PP)	-11.840	0.29086
Johansen's Trace Test (JOT)	-10.777	0.56565

III. A DECADAL RUPEES /USD, RUPEES/YEN NEXUS

$Y[i] = 0.2892 X[i] + 40.9972 + R[i]$, $R[i] = 0.9983 R[i-1] + eps[i]$, $eps \sim N(0, 0.4522^2)$
(0.0135)   (0.8041)   (0.0017)

$R[2409] = 1.1875$ (t = 0.215). X and Y do not appear to be cointegrated.

Unit Root Tests of Residuals

	Statistic	p-value
Augmented Dickey Fuller (ADF)	-2.737	0.18434
Phillips-Perron (PP)	-9.885	0.39628
Johansen's Trace Test (JOT)	-12.114	0.45234

IV. A DECADAL RUPEES /GBP, RUPEES/EURO NEXUS

$Y[i] = 0.5551 X[i] + 23.6535 + R[i]$, $R[i] = 0.9981 R[i-1] + eps[i]$, $eps \sim N(0, 0.3717^2)$
(0.0073)   (0.6540)   (0.0020)
$R[2409] = 6.2778$ (t = 1.696). X and Y do not appear to be cointegrated.

Unit Root Tests of Residuals

	Statistic	p-value
Augmented Dickey Fuller (ADF)	-1.822	0.60064
Phillips-Perron (PP)	-10.821	0.34581
Johansen's Trace Test (JOT)	-8.380	0.79173

V. A DECADAL RUPEES /GBP, RUPEES/YEN NEXUS

$Y[i] = 0.1636 X[i] + 43.3659 + R[i]$, $R[i] = 0.9977 R[i-1] + eps[i]$, $eps \sim N(0, 0.4791^2)$
(0.0114)   (1.0101)   (0.0017)
$R[2409] = 3.9425$ (t = 0.681). X and Y do not appear to be cointegrated.

Unit Root Tests of Residuals

	Statistic	p-value
Augmented Dickey Fuller (ADF)	-3.105	0.08621
Phillips-Perron (PP)	-11.354	0.31704
Johansen's Trace Test (JOT)	-12.775	0.40307

VI. A DECADAL RUPEES /EURO, RUPEES/YEN NEXUS

$Y[i] = 0.3584 X[i] + 31.8575 + R[i]$, $R[i] = 0.9977 R[i-1] + eps[i]$, $eps \sim N(0, 0.4563^2)$
(0.0164)   (1.1959)   (0.0017)
$R[2409] = 1.5407$ (t = 0.279). X and Y do not appear to be cointegrated.

Unit Root Tests of Residuals

	Statistic	p-value
Augmented Dickey Fuller (ADF)	-3.135	0.08117
Phillips-Perron (PP)	-11.171	0.32692
Johansen's Trace Test (JOT)	-15.055	0.23337

VII. JOHANSEN-PROCEDURE

Test type: maximal eigenvalue statistic (lambda max), without linear trend and constant in cointegration. Eigenvalues (lambda): [1] 6.358527e-03 3.387231e-03 2.196880e-03 8.192158e-04 1.030844e-18.

Values of test-statistic and critical values of test:

	Test	10pct	5pct	1pct
r <= 3 |	1.97	7.52	9.24	12.97
r <= 2 |	5.28	13.75	15.67	20.20
r <= 1 |	8.14	19.77	22.00	26.81
r = 0 |	15.30	25.56	28.14	33.24

Eigenvectors normalized to first column: (These are the cointegration relations)

	USD.l1	GBP.l1	EURO.l1	YEN.l1	constant
USD.l1	1.0000000	1.0000000	1.000000	1.000000	1.0000000
GBP.l1	-1.2329991	0.4996497	-1.927498	3.320078	-0.5455442
EURO.l1	0.4331092	-2.3966105	1.161714	-2.254249	0.5582187
YEN.l1	1.8188376	0.1942730	-1.565801	-1.797876	-0.5772077
Constant	-91.4634041	61.0022802	109.617970	-107.177244	-13.4335556

Weights W: (This is the loading matrix)

	USD1.l1	GBP1.l1	EURO1.l1	YEN1.l1	constant
USD.d	-0.0010420547	0.0002735402	-0.0001395311	-1.403585e-04	2.402797e-17
GBP.d	0.0004162503	0.0000798201	0.0010066285	-3.481939e-04	-4.440442e-17
EURO.d	0.0003762953	0.0023456033	0.0002067531	-1.989772e-04	1.151137e-17
YEN1.d	-0.0020686867	0.0014709521	0.0007021557	-6.884138e-05	2.956037e-18

5. DISCUSSIONS AND CONCLUSION

The results (Johansen-Juselius Cointegration Tests) from the entire sample show that the foreign exchange rate of US dollar, Great Britain Pound, EURO and Japanese Yen appear not to be integrated. The value of r = 0 test 15.30 is less than 5% critical value i.e. 28.14, hence we fail to reject null hypothesis i.e. there is no cointegration among four foreign exchanges. The null hypothesis of no cointegration between the US dollar and the Great Britain Pound cannot be rejected applying Engle-Granger Cointegration Tests. At the 5 percent level the critical value of the ADF statistic is -2.251 and p- value is 0.40181. Engle-Granger Cointegration Tests shows null hypothesis of no cointegration between US dollar and EURO cannot be rejected. The reported ADF statistic, -2.324 and p-value is 0.36780. We can say the linkage between the US dollar and EURO less.

Another interesting observation from a decadal rupees/USD, rupees/yen nexus were found to be non-cointegrated with the help of Engle-Granger Cointegration Tests. The reported ADF statistic, -2.737 and p-value is 0.18434. A decadal rupees /GBP, rupees/EURO nexus and its null hypothesis of no cointegration between GBP and EURO cannot be rejected by applying Engle-Granger Cointegration Tests. The reported ADF statistic, -1.822 and p-value is 0.60064. A decadal rupees/GBP, rupees/Yen nexus reveals there is no cointegration between them revealed by Engle-Granger Cointegration Tests and the reported ADF statistic, -3.105 and p-value is 0.08621. Engle-Granger Cointegration Tests shows there is no cointegration between GBP and Yen. The ADF statistic is -3.105 and p-value is 0.08621.

Lastly, a decadal rupees /euro, rupees/yen nexus reveals that there is no cointegration between them with the help of Engle-Granger Cointegration Tests and the reported ADF statistic is -3.135 and p-value is 0.08117.

In sum, the evidence from the entire sample that foreign exchange movement is not cointegrated among the USD, GBP, EURO and YEN. This implies that the four major currencies are not related to the each other. These results also imply that the performance of the USD vs. GBP, USD vs. EURO, USD vs. YEN, GBP vs. EURO, GBP vs. YEN, EURO vs. YEN have no impression on the other foreign exchanges.

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