Journal of Advances and Scholarly Researches in Allied Education
Vol. 19, Issue No. 5, October-2022, ISSN 2230-7540

Analytical Study on Factors Influencing the International Reserves of Selected Countries

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Abstract - Studies of foreign reserves have increased in popularity among academics during the last decade. A lot of people are thinking about looking at the motivations behind countries' decisions to hoard foreign exchange reserves again after the current financial crisis in Asia. The accumulation of foreign reserves around the globe has increased dramatically in recent years. Large amounts of foreign currency reserves have been amassed in recent decades, particularly by rising countries. Countries need foreign reserves for a variety of reasons, including protecting themselves against a sudden shortage of foreign currency and facilitating exports by means of managing exchange rates. In this research, we looked at how a few of macroeconomic variables affected these buffers. The stationarity of the variables in the yearly frequency time series data was examined using the Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests. All variables were found to be co-integrated, indicating a long-term link. Various parameters have been explored in recent research on the effects of having foreign reserves.

Keywords - International reserves, hoardings, developing economies, determinants, influencing factors

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INTRODUCTION

Since the East Asian crisis of 1997–1998 and particularly in its aftermath, international reserves held by central banks of emerging countries have grown dramatically. The total amount of foreign currency reserves held by developing nations rose from $6,12,253 in 2001 to $58,88,373 in 2011. Now, the biggest challenge for central banks in emerging markets is how to handle their humongous reserves and the costs involved with keeping them safe. One of the most important factors influencing the bottom line is a country's foreign reserves, which is the case with emerging nations like India. They're crucial to the process of exchanging currency. Despite all the theoretical arguments, the stock of foreign reserves of many emerging and developing countries, including India, has expanded dramatically even after official pronouncements about adherence to the flexible exchange rate system (Flood and Marion, 00).

To finance payment imbalances directly by intervening in exchange markets to impact the currency exchange rate and/or for other reasons, central banks keep a stockpile of foreign assets known as international reserves (Balance of Payments Manual, [International Monetary Fund], 2014). Gold, SDRs, deposits in other currencies, bonds issued by the central bank, and reserve positions at the IMF are all examples of what are known as a country's international reserves or foreign exchange reserves. Almost two-thirds of the world's entire foreign reserves are held by only 10 countries. They originate mostly in Asia. At the end of 2014, China topped the list with an economy of $3.86 trillion U.S. dollars. The country only had $822 billion USD ten years ago. A distant second is Japan, at $1.2 trillion US (as on June 2015). India, with its USD 351 billion, ranks eighth on the list.

A lot of people are thinking about international reserve hoarding again because of the current Asian financial crisis. Transactional need, precautionary motivations, the collateral asset argument, and mercantilist conduct are all primary reasons for maintaining a stockpile of foreign currency reserves. Despite a plethora of research aimed at identifying the criteria that matter most for foreign reserves, the argument is far from over. The anecdotal opinion that the purpose and usefulness of foreign reserves have developed along with advances in global financial markets could explain why it's so hard to explain people's behavior when it comes to keeping international reserves. For instance, due to ongoing financial globalization and cutting-edge developments in international capital markets, maintaining overseas reserves is now more vulnerable to capital account transactions. The lessons of the recent financial crisis have also

highlighted the significance of expectations, policy credibility, and institutional frameworks in establishing an appropriate number of overseas reserves.

The foreign exchange reserves of a country are the assets maintained by its central bank (or monetary authority) that may be changed into another financial medium and utilized to impact the value of the country's exchange rate with absolute certainty. Reserves held by central banks that are convertible into other currencies, gold, special drawing rights (SDRs), and the reserve position at the International Monetary Fund (IMF) all fall under the umbrella term of "international reserves," which is also known as "foreign exchange reserves" in the literature (Bahmani-Sokoke and Brown, 2002). According to the IMF, foreign reserves are "those external assets that are easily accessible and controlled by monetary authorities, for direct financing of payment imbalances via intervention in exchange markets, to effect currency exchange, and/or for other reasons" (IMF Balance of Payments Manual, 1993). Countries need foreign reserves for a variety of reasons, including protecting themselves against a sudden shortage of foreign currency and facilitating exports by means of managing exchange rates. Therefore, there are two primary uses for foreign exchange reserves:

Various parameters have been explored in recent research on the effects of having foreign reserves. Chin-Hong et al. (2011) conducted an empirical investigation into the effects of five explanatory factors on Malaysia's foreign exchange reserves. Size of economy, real effective exchange rate, openness, BOP, and opportunity cost of reserves are all relevant factors. The econometric model used in their research is as follows:

IRGDP = 0+ 1LGDP + 2LREER + 3LBOPGDP + 4LMMR + εt

Where IRGDP, LGDP, LREER, BOPGDP, LMMR and ε are the ratio of international reserves

natural logarithm of GDP, real effective exchange rate, total balance of payments as a percentage of GDP, money market rate, and error term. They arrived at this verdict after determining that every model variable was statistically significant. In example, foreign reserves are favorably connected to economic size and the actual effective exchange rate, while they are negatively affected by the balance of payments and the opportunity cost of retaining reserves.

In the past, empirical investigations on foreign reserveshave demonstrated a reasonably consistent long-run demand for reserves based on a restricted range of explanatory factors like GDP (GDP). Economic size, exposure to current account volatility, exposure to capital account volatility, exchange rate flexibility, and opportunity cost are the five characteristics that Gosselin and Nicolas (2005) identified as having the greatest impact on reserve levels. If central banks are more vulnerable to shocks from the outside world, they will accumulate more reserves over time.

LITERATURE REVIEW

Mohammad Kashif et.al (2017) Increases in countries' foreign reserves have occurred at a rapid pace recently. The top 10 largest holders are primarily from Asia, and these reserves are being hoarded by many countries, especially emerging ones, because of the competition they provide. India, surprisingly, ranks just eighth. Certain variables impact international reserves, and developing nations like India are in a prime position to stockpile them. In this research, we looked at how a small number of macroeconomic variables affected these buffers. The stationarity of the variables in the yearly frequency time series data was examined using the Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests. All of the variables were found to be co-integrated, indicating a long-term link. In contrast to prior research, when an error correction mechanism (ECM) was used to get short-run dynamics, a negative association was shown for trade openness (TRDOP). India's persistent trade deficits may explain why TRDOP correlates negatively with the country's foreign exchange reserves.

P. Sridhara et.al (2017) Using data from the years 1980-2014, this research analyzed the effect of economic development on Brazil's foreign reserves holdings within the framework of Error Correction Mechanism. The findings show that economic expansion is crucial. Our model estimate suggests a favorable long run association between economic expansion and foreign exchange reserves, and we use this to make that case. The negative and statistically significant estimate for the error correction component verified the accuracy of our model. In addition, our model indicated that economic expansion is related to the short term. Over 40% adjustment speed indicates that mistake repair term is balancing out imbalance from the prior year at a pace of 40.4%.

Verma Amanet.al (2021) For the sake of stability and liquidity, a nation maintains a stockpile of foreign currency reserves. The nation has sufficient foreign reserves to finance both routine government activities and emergency situations. Having a sufficient number of reserves allows a nation to remain financially independent and secure.

Yeonjeong Lee et.al (2020) From January 1997 to May 2020, this article analyses the correlation between shifts in international reserves and shifts in foreign exchange rates for five Far Eastern nations (China, Japan, Taiwan, Hong Kong, and Korea). To understand why the central bank decides to intervene, we employ a quantile Granger causality test and a quantile autoregressive model. The most important takeaways from this research are as

follows. We begin with China and Hong Kong, where mercantilists are acquiring foreign reserves in response to the appreciation of currencies. The desire of the monetary authorities in Korea and Japan to stabilize their currencies proactively is rather considerable. Second, we pinpoint the imbalanced nature of the variables' causal connection. When looking at significant regression coefficients indicating a causal association, these traits are shown to be more prevalent worldwide. We conclude by confirming the characteristics of the connection between the variables as a function of quantile and tail. Particularly, Korea has a more pronounced tail-dependence than most other nations.

ANDRIYANI, Kurniaet.al (2020) The purpose of this research is to identify and examine the variables that have an impact on Indonesia's foreign currency reserves. We take into account the variables of foreign debt, currency rate, inflation, and exports by referencing earlier research. From January 2016 through December 2018, we use data from the Central Bank of Indonesia (BI), the Central Bureau of Statistics (BPS), and the International Monetary Fund (IMF) to conduct an Autoregressive Distributed Lag analysis. According to our findings, Indonesia's foreign currency reserves fluctuate in tandem with changes in the country's external debt, exchange rates, inflation, and exports. Foreign debt has a large and beneficial influence on a country's foreign currency reserves. Indonesia's foreign currency reserves are significantly impacted in a negative way by the current exchange rate. However, our research shows that exports have a considerable and beneficial influence on Indonesia's foreign currency reserves, but inflation has no discernible effect. It is hoped that this research would help policymakers in Indonesia better manage the country's foreign currency reserves, leading to more stable economic growth.

RESEARCH AND METHODOLOGY

Methodology and Data Explanation The ratio of foreign reserves to GDP was the dependent variable, while real GDP growth and TRDOP (as measured by the total value of exports and imports) were utilized as independent variables. By employing time series data, we performed unit root tests for stationarity using the augmented ADF and the Phillips-Perron PP procedures. Using the co-integration methods pioneered by Johansen and Julius, this research analyzed the connection between these variables in India (1990). Costs associated with ECM were calculated. Short-run dynamics and the rapidity of long-run equilibrium changes are brought together in Engle and Granger's (1987) ECM. It was designed for cointegrated time series that are not stationary. Accordingly, using an ECM is more nuanced than employing a VAR on first-differenced data. Foreign exchange reserves were shown to be correlated with a set of macroeconomic variables in a model. The ratio of India's foreign exchange reserves to its gross domestic product may be predicted using the following regression equation:

$$RES = f(ECON, TRDOP) \quad (1)$$

The explicit form of this model is:

$$(RES)_t = \mathbf{b}_0 + \mathbf{b}_1 (ECON)_t + \mathbf{b}_2 (TRDOP)_t + \mathbf{f}_t \quad (2)$$

The variables were all expressed as logarithms. The goal of the transformation was to eliminate the possibility of seeing non-normally distributed or multiplicatively increasing mistakes in the residuals. In its logarithmic version, the model was:

$$\text{Ln } (RES)_t = \mathbf{b}_0 + \mathbf{b}_1 \text{Ln } (ECON)_t + \quad (3)$$

$$\mathbf{b}_2 \text{Ln } (TRDOP)_t + \mathbf{f}_t$$

where RES is the ratio of foreign exchange reserves to gross domestic product, ECON is the country's economic growth as measured by real GDP, TRDOP is trade openness as measured by the total value of exports and imports as a percentage of GDP, and is an error term.

The research used secondary sources, including the International Financial Statistics dataset from the IMF and the World Development Indicators dataset from the World Bank. The used data ranged from 1984 to 2014 and were collected annually. All the variables in this analysis were transformed into their logarithm forms for ease of comparison. John Tukey's book Exploratory Data Analysis provided quantitative ways to evaluate the transformation using rank statistics of residuals. If the residuals are symmetrical after taking the log, then it is likely the appropriate kind of repression. Due to this, we had to use a natural logarithm to modify the variables. The variables should also be changed to their natural logarithm form if it is considered that residuals indicate mistakes that accumulate multiplicatively. Some macroeconomic factors that might affect foreign exchange reserves are assumed to be related in the study's model (RES). Several diagnostic procedures were used to look at the data's time series characteristics and draw conclusions. Stationarity was examined using both the ADF and PP unit root tests. International reserves and their drivers were subjected to a long-run relationship test using a co-integration technique devised by Johansen and Julius (1990). If the variables under consideration are co-integrated, the cointegrating vector may be normalized with regard to estimations of its demand function based on foreign reserves. Engle and Granger's (E&G) ECM may be used to confirm not only the long-run but also the short-run dynamics (1987). To conduct his co-integrating analysis, Johansen used the following model.

$$k\text{-}1$$

$$\mathbf{D}\,Y_t = \mathbf{P}Y_{t-1} + \sum_{i=1} \mathbf{C}_i \mathbf{D}Y_{t-i} + \mathbf{m}D + \mathbf{f}_t \quad (4)$$

where Y_t represents vector of non-stationary variables. **C**, Π and λ denote matrices of parameters which have to be estimated. The long-run relationship could be determined by the rank of matrix Π, therefore decomposed as Π = α β, where α holds adjustments and β contains co-integrating vectors. Δ refers to change while ε denotes error term. Johansen anticipated two likelihood ratio statistics namely trace statistics and the max-eigen value statistics. The significant eigen values of Π determines the number of co-integrating vector(s) with the help of these statistics. The trace statistic examines the null hypothesis of *r* co-integrating vector(s). As soon as the number of co-integrating vectors were ascertained, examining the hypothesis on adjustment as well as co-integrating vectors was made possible.

Table 1(a). Augmented Dickey Fuller (ADF) Test

	Level		First Difference	
Variables	*t*-Statistics	*P*-Value	*t*-Statistics	*P*-Value
RES	−0.29	0.91	−4.44	0.00*
ECON	0.94	0.99	−4.90	0.00*
TRDOP	−0.63	0.98	−3.91	0.00*

Source: Authors owns.

Note: * Denotes rejection of null hypothesis at 5 per cent level.

Table 1 (b). Phillips-Perron (PP) Test

	Level		First Difference	
Variables	*t*-Statistics	*P*-Value	*t*-Statistics	*P*-Value
RES	−0.35	0.90	−4.44	0.00*
ECON	0.94	0.99	−4.93	0.00*
TRDOP	0.50	0.98	−3.90	0.00*

Table 2. Johansen Co-integration Test

Max-						
Null	Trace	Critical	*P*-	Eigen	Critical	*P*-
Hypothesis	Statistics	Value	Value	Value	Value	Value
r = 0*	40.35	29.80	0.00	25.09	21.13	0.01
r $ 1	15.25	15.49	0.05	10.08	14.26	0.20
r $ 2*	5.17	3.84	0.02	5.17	3.84	0.02

Source: Authorsowns.

Notes: Both Trace and Max-Eigen value tests indicate one co-integrating equation at 5 per cent level; * denotes rejection of null hypothesis at 5 per cent level.

The study used secondary data obtained from the dataset of IMF's International Financial

The World Bank's statistical database and its World Development Indicators. For this study's analysis of the modelled variables, econometric instruments were used. The estimate was performed using the E-views software, and the results are tabulated for readability. To facilitate comparison, the variables were transformed into their logarithmic forms. Some macroeconomic factors that might affect foreign exchange reserves are assumed to be related in the study's model (RES). We used a battery of diagnostic tools to look at the data's time series characteristics and draw some conclusions. In order to guarantee that our variables were stationary, we employed the well-known Augmented Dickey-Fuller unit root tests. The co-integration test is useful for analyzing the long-term connection if the variables are discovered to be non-stationary.

DATA ANALYSIS

Both the ADF and PP unit root tests show that RES, ECON, and TRDOP are not level, hence the null hypothesis of unit roots for each variable may be accepted. The results of ADF and PP tests for the order of integration of each variable are shown in Table 1(a) and (b), respectively. According to the findings of the tests, the variables were not stationary at the level but were stationary at the first difference. In light of this, it was decided to treat everything as an I (1) procedure across the board. And to deal with the problem of structural breaks, the dummy was included into the model, and the Bai-Perron (1998) test was used to check for them; the results of which offer a few structural fractures. Finding the dummy to be non-significant at the 5% level suggests that structural breaks have no influence on the model and that the coefficients are undistorted. The question of whether or not the variables LnRES, LnECON, and LnTRDOP had an innate propensity to move together in the long run was examined after it was shown that these series

were non-stationary at level and exhibited stationarity at first difference. For your convenience, Table 2 displays the outcomes of Johansen's co-integration test. In other words, the variables were determined to be co-integrated using a single co-integrating vector.

Johansen Co-integration Test

Johansen's co-integration test is the gold standard for counting the number of co-integrating relationships between the series. There may be up to n-1 co-integrating linkages between n I (1) variables if they were jointly modelled in a dynamic system. A battery of experiments was run to establish the co-integrating rank r. First, the presence of at least one co-integrating connection was established by testing the null hypothesis of r = 0 against r 1. It follows that there are no shared trends or co-integrating connections if r = 0. If this is not the case, then the series may have had co-integrating connections.

The VAR framework allowed for a Johansen co-integration test to be performed. Akaike Information Criterion (AIC) was used to choose the order of the VAR, and the result was a 2 order. Table 2 displays the results of a Johansen co-integration test. At a 95% confidence level, the lack of co-integration (r = 0) may be dismissed. The findings revealed a novel co-integration connection between foreign reserves and their drivers. So, it turns out that there is a link between foreign exchange reserves, economic growth, and trade deficits and open positions.

The estimating procedure started with the reporting of the co-integrating regression of the model's long-run relationship, which was possible because of the discovery of a single co-integrating vector among the variables (see Table 3). This demonstrates the co-integration equation:

$$\text{Ln } (RES)_t = -83.14 + 7.91(ECON) - 6.03(TRDOP)$$

(1.7) (0.99)

(6)

$$+ \mathbf{f}_t$$

R^2 =0.47 DW = 2.43 SSE = 0.28

Note: Standard errors are in parenthesis.

Explanatory variable signs are as predicted in the co-integrating equation (5). When it comes to the economy, the need for foreign reserves rises in direct proportion to the rate of economic growth of the country. Therefore, this variable's sign is anticipated to be positive in the empirical analysis. While many prior studies, including Choi and Baek (2004) and Obstfeld et al. (2009), found a positive sign for TRDOP, we predicted a negative one for India given its trade deficits and severe economic crisis during our study period.

The ECON has been shown to have a more significant impact on international reserves. That's a good indicator for our research. That means that if people's incomes rise, so too should their reserve funds. Earlier research, including that of Chakravarty (2009), Choi and Baek (2004), and Chaudhry et al., supports this conclusion (2014). These studies have shown that an expanding economy is associated with a rise in foreign exchange reserves. We found that the elasticity values obtained by Sehgal and Sharma (2008) and Chakravarty (2009) were much lower than those we found. Our research indicates that an increase of only 1% in economic growth results in an increase of roughly 8% in overall foreign reserves. This is because our research period coincided with significant fluctuations in both the international and Indian economies. The next section will show that the same pattern holds true for short-run elasticities. However, TRDOP shows a negative indication, which conflicts with the findings of researchers like Gosselin and Parent (2005). This might be due, in part, to India's persistent trade deficits since 1980 and the country's enduring economic crisis, which began in early 1985. Since 1980, India's imports, especially of crude oil, gold, and silver, have grown rapidly, leading to widening trade imbalances. The estimated model's negative sign for TRDOP might be due to this. According to the report, India's trade strategy should priorities increasing exports while decreasing imports.

In addition to this, India's BoPs issues began in the year 1985. At the end of the 1990s, the economy was in shambles. The Indian government was on the verge of insolvency. Loan applications were turned down by India's national bank, the Reserve Bank. The Indian government airlifted national gold holdings as a commitment to the IMF in return for a loan to offset external payment imbalances after the country's international reserves dwindled to the point where it could barely fund three weeks' worth of imports. It's notable that the year of the economic crisis, 2014, comes within the time frame of this study's investigation, which extends from 1984 to 2014. As a result, TRDOP was shown to have a negative indicator in this research. All explanatory factors were found to be statistically significant at the 5% level in the estimations, indicating that India should formulate a trade strategy that may lead to increase in exports while also keeping sufficient foreign reserves to service external payment imbalances. According to Rodrik and Velasco (1999) and Garcia and Soto (2004), an economy may be considered cautious if it maintains foreign reserves equivalent to the total of its external debt paid within one year. Thus, India should save sufficient foreign reserves to cover its ongoing external payment deficits.

Error Correction Model

Following the estimation of the long-term model, the short-term dynamics coefficients with potentially significant repercussions were computed. In order to

account for the short-run interactions and the pace of adjustment towards long-run equilibrium, an ECM was computed. The following is the specification of the ECM to be estimated, based on the representation theorem proposed by Engle and Granger (1987):

$$\mathbf{D}\,\mathrm{LnRES}_t = \mathbf{a}_0 + \mathbf{R}\mathbf{b}_i\,\mathbf{D}\,\mathrm{LnRES}_{t-i} + \mathbf{R}\,\mathbf{c}_i\mathbf{D}\mathrm{LnECON}_{t-i} \quad (7)$$

$$+ \mathbf{R}\,\mathbf{d}_i\mathbf{D}\mathrm{LnTRDOP}_{t-i} + \mathbf{m}\mathrm{ECT}_{t-1} + \mathbf{f}_i$$

where all variables were defined as before and ECT is the error correction term. In this model, lag selection was based on AIC and Schwarz Criterion (SC) which suggested appropriate lag as two. All lagged explanatory variables demonstrated expected signs in the ECM. The coefficients of ECON and TRDOP for short-run model were 2.13 and −1.94, respectively (Table 4). Hence, the results suggested that a 1 per cent increase in ECON would fetch more than a 2 per cent

Table 3. Normalized Co-integrating Coefficients

	RES	ECON	TRDOP
Normalized **b**	1	7.91	−6.03
		(1.7) *	(0.99) *

Source: Authors owns.

Notes: * Denotes significance at 5 per cent level; standard error in parenthesis.

Table 4. Error Correction Model

	DRES
C	0.279 (0.11) *
$DRES_{t-1}$	0.052 (0.17)
$DRES_{t-2}$	0.105 (0.20) *
$DECON_{t-1}$	2.133 (1.35) *
$DECON_{t-2}$	0.567 (1.22)
$DTRDOP_{t-1}$	−1.936 (1.11) **
$DTRDOP_{t-2}$	−0.962 (0.93)
ECT_{t-1}	−0.444 (0.13) *
R-squared D-W	0.47 (2.43)
F-Stat S.E.	2.08 (0.28)

Source: Authorsowns.

Notes: denotes significance at 5 per cent and 10 per cent levels; standard errors are in parenthesis.

Table 5. Diagnostic Tests

Test	Statistics	*P*-Value	Conclusion
Breusch-Godfrey Serial Correlation LM Test	11.76	0.23	No serial correlation
BPG Heteroskedasticity Test	89.64	0.32	No heteroskedasticity
Ramsey RESET Test	6.42	0.09	No misspecification
Jarque-Bera	12.03	0.25	Normally distributed
Normality test			

Source: Authorsowns.

rise in overall foreign reserves, but a rise in TRDOP would cut approximately 2% from those reserves in the immediate term. Since India has had a persistent trade imbalance for some time, this comes as no surprise. The model's significance for all variables was confirmed. Importantly, a substantial negative ECT coefficient was discovered at the 5% level. It was revealed that the suggested rate of adjustment after ECT was 0.44 times faster than what was actually seen. According to the results, almost 44% of the imbalance is restored annually. The ECT's negative value indicated that decreasing foreign reserves was necessary to preserve the long-run status quo. Because of the quicker rate of adjustment, we claim that the Reserve Bank of India is actively managing its reserves.

The diagnostic procedures were carried out at last. Results from the diagnostic procedures are summarized in Table 5. The test for serial correlation demonstrated that the alternative hypothesis—that the series were not serially correlated—was incorrect. An examination of heteroscedasticity revealed

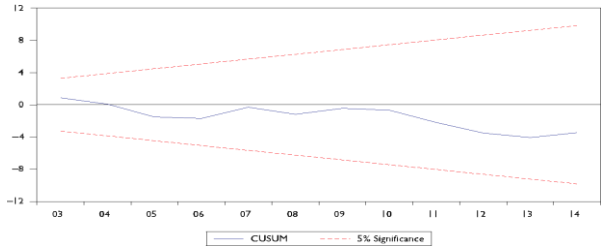

Figure 3. Cumulative Sum of Recursive Residuals (CUSUM) test

Source: Based on authors' data analysis.

Integrals of all variables followed the same I-order pattern. The co-integration test conducted by Johansen revealed a single co-integrating equation, with all control variables displaying the predicted signs (positive for ECON and negative for TRDOP). The model also indicated that the variables were 5% significant.

In this research, ECON was shown to have a significant, positive effect on foreign currency reserves, implying that a growing economy leads to a rise in foreign currency reserves. This is in line with prior research which has shown that a country's reserve assets should grow in tandem with its rising level of life. TRDOP was the only independent variable for which a negative correlation was discovered. As far as we're aware, nobody has spoken about this before. This research indicates that the persistent trade deficits of Indian BoPs are the root cause of the negative correlation between TRDOP and foreign exchange reserves. An examination of this issue suggested that the severe economic crisis in India from early 1991 and the trade deficits of Indian BoPs may be to blame.

According to the findings presented here, India's trade policy should be crafted in a way that promotes export development while also ensuring the country has sufficient foreign exchange reserves to cover any gaps in its external payments. Short-term reserve holdings were found to be due, as predicted, to differences in BoPs. Therefore, policymakers should come up with a plan to reduce the gap between the two BoPs by boosting exports and luring more FDI. The establishment of oil funds, investments abroad, and the cancellation of external debt are all viable options for spending surplus foreign reserves.

Augmented Dickey Fuller (ADF) Unit Root Test:

The variables RES, ECON, and TRDOP are all non-stationary at the mean since the null hypothesis of unit root was accepted for all of them in an Augmented Dickey-Fuller (ADF) test. All variables exhibit I (1) order and become stationary at first difference. It's possible that I-(0) variables will start to appear, and that a long-term link will develop between the variables. We utilized the Johansen co-integration test to verify this.

Table 6: ADF Unit Root Test

Level		First difference	
t-statistics	P-Value	t-statistics	P-Value
-1.74	0.39	-4.49	0.00*
2.81	1.00	-4.24	0.01*
-0.87	0.78	-4.83	0.00*

* Denotes rejection of null hypothesis at 5% level

The VAR system's right-hand-side variables all have the same lag length in the equations. As a result, the model may be over-parameterized, which might reduce its flexibility. Choosing a suitable lag duration that prevents misspecification and over-parameterization is crucial in such cases. Commonly used evaluation criteria were used for this work. These included the Hannan-Quinn (HQ) criterion, the Akaike Information Criterion (AIC), and the Schwartz Criterion (SC). Based on these criteria, a 2-year lag seems reasonable.

Table 7: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-24.56674	NA	0.001344	1.901154	2.042599	1.945453
1	82.49960	184.5971	1.56e-06	-4.862042	-4.296264	-4.684847
2	100.4411	27.2215*	8.63e-07*	-5.47869*	-4.48858*	-5.16860*

* Indicates lag order selected by the criterion

the absence of serial correlation between the series (the null hypothesis). The residuals are normally distributed, and the Breusch-Pagan-Godfrey test for heteroskedasticity returns no significant results. The

diagnostic procedures did not reveal any errors in our model's functional form definition.

Table 8: Vector Autoregressive Model

	RES	TRDOP	ECON
RESt-1	0.975 (0.184) *	0.162 (0.046) **	0.122 (0.037) *
RESt-2	-0.491 (0.201) *	-0.097 (0.051) **	-0.123 (0.041) *
TRDOPt-1	0.801 (0.733)	1.003996 (0.185) *	-0.125 (0.150)
TRDOPt-2	0.085 (0.691)	-0.260 (0.175)	0.099 (0.141)
ECONt-1	1.407 (0.818) **	-0.301 (0.207)	1.163 (0.167) *
ECONt-2	-1.274 (0.842)	0.256 (0.213)	-0.145912 (0.17259)
C	-4.156 (2.404) **	1.126 (0.609) **	-0.344 (0.492)
R-squared	0.752845	0.872745	0.996425
Adj. R-squared	0.685439	0.838039	0.995450
S.E. equation	0.246988	0.062597	0.050622
F-statistic	11.16882*	25.14680*	1021.890*

denotes significant at 5% and 10% level

CONCLUSION

The international reserves of emerging nations like India have grown rapidly during the last decade. India, with its USD 351 billion, ranks eighth on the list. A lot of people are thinking about international reserve hoarding again because of the current Asian financial crisis. It was designed for cointegrated time series that are not stationary. Accordingly, using an ECM is more nuanced than employing a VAR on first-differenced data. Based on the results of the ADF and PP unit root tests, it is possible to reject the null hypothesis of unit roots for RES, ECON, and TRDOP at the 5% significance level. As a result, there may be a positive relationship between reserves and metrics like the capital-to-GDP ratio. In most cases, being able to adjust the exchange rate is crucial.

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