Macroeconomic Drivers of International Reserve Accumulation in Current International Financial Architecture: A comparative Analysis of Emerging Market Economies

Abstract

The international financial architecture is going through a reformation. Among the economies, the Emerging Market Economies (EMEs) are going through this situation after the frequent occurrences of the crises. In this scenario, the EMEs holds significant amount international reserves for different purposes. It plays a major role in relaxing the impossible trinity in EMEs. But these reserves are determined by certain macro-economic factors This paper finds certain macro-economic determinants of international reserves and the nature of the relationship using Bootstrap ARDL methodology. Except Egypt, there is no long -run relationship between international reserves and its major determinants. The study concludes that the international reserves and determinants have a short-run relationship rather than long-run relationship in EMEs.The policy makers can formulate efficient reserve management strategy by acknowledging this short-run relationship.

Key words: International reserves, EMEs, Bootsrap ARDL, Impossible Trinity, Short-run

1.0 Introduction

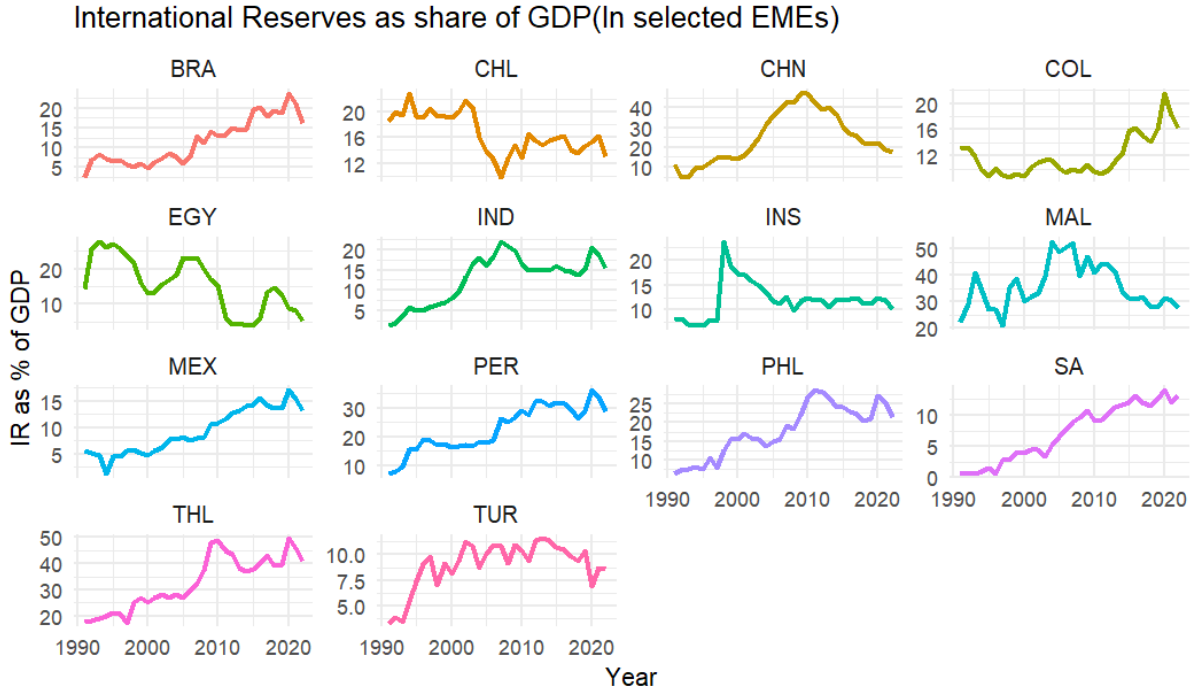
During the 1990s and the early 2000s, the emerging market economies(EMEs) faced at least nine major financial crises, which were primarily driven by the capital account factors compared to current account problems. These crises were difficult to handle due to their speed, the extent of capital flow reversals, and associated contagion effects(Kawai,2010).Traumatized by the frequent occurrences of financial crises in EMEs, the policymakers arrived at a consensus view that the existing international financial architecture was not effective in helping the crisis-affected economies manage and overcome the crisis, and that the IMF even exacerbated the severity of the crisis. There are at least two important lessons to draw from this. Firstly, on the domestic front, if a country is to be increasingly integrated with international financial markets, they must have the capacity to prudently manage the forces of financial globalization in order to deal with any of its undesirable impacts. The EMEs needed to strengthen their domestic economic underpinnings by creating effective frameworks for achieving macroeconomic and financial stability in order to make them more resilient to domestic and external shocks. Secondly, on the international front, the reformation of international financial architecture has happened especially in EMEs.A major thrust of the reform philosophy was that the international financial market contained systemic problems, which could threaten the stability and health of many EMEs that were being integrated and so exposed to the global financial markets. As part of reforming the existed financial architecture, the EMEs has put efforts to increase their international reserves[1] holdings in a large scale. The international reserves are defined as "official public sector assets controlled by monetary authorities to finance payment imbalances and regulate the magnitude of these imbalances through affecting the exchange rate and/or for other related purposes"(IMF 2001). The purpose of holding international reserves varies based on the interests of each country. But the main motive of accumulating international reserves is to ensure stability in the economy in terms of purchasing power. Therefore, international reserves serve as a mechanism responsible for compensating the balance of payments. Hence, international reserves function to compensate for either internal or external macroeconomic and financial imbalances(Benil et al,2022).These reserves, especially for developing and EMEs are required to mitigate the negative internal and external shocks by supporting debt payments and boosting credibility in international financial markets. Thus the role of international reserves are regarded as the critical variables in EMEs because they face increased financial volatilities and macroeconomic uncertainties. Thus, the EMEs have started to accumulate international reserves.

The figure 1 shows the international reserves as percentage of GDP in selected EMEs over the years. From the figure, it is clear that the majority of the EMEs hold international reserves more than 20% of their GDP. This trend validates the accumulation process of international reserves in EMEs. The trend of increasing reserves is specific for the developing or emerging economies as the industrial countries are still maintaining their reserve holdings at a stable level of below 5 per cent of their gross domestic product (GDP). However, there is a miraculous four times increase in the reserve accumulation of the EMEs since 1990 in general, and since the Asian crisis in particular. The East Asian Crisis of 1997–1998 has also impacted the IR hoardings as it has been seen that the

[1] The international reserves are "external assets that are immediately available and controlled by the central banks to finance balance of payment needs and to intervene the foreign exchange markets and for other related purposes"(IMF)

economies with a high level of reserves have not experienced the heat of this crisis as badly as experienced by those who were not having enough reserves to deal with the crisis. Moreover, in the recent global recession crisis of 2007, IR have again worked as a protective layer for some economies(Kaur,2024).

Figure 1:International Reserves as share of GDP



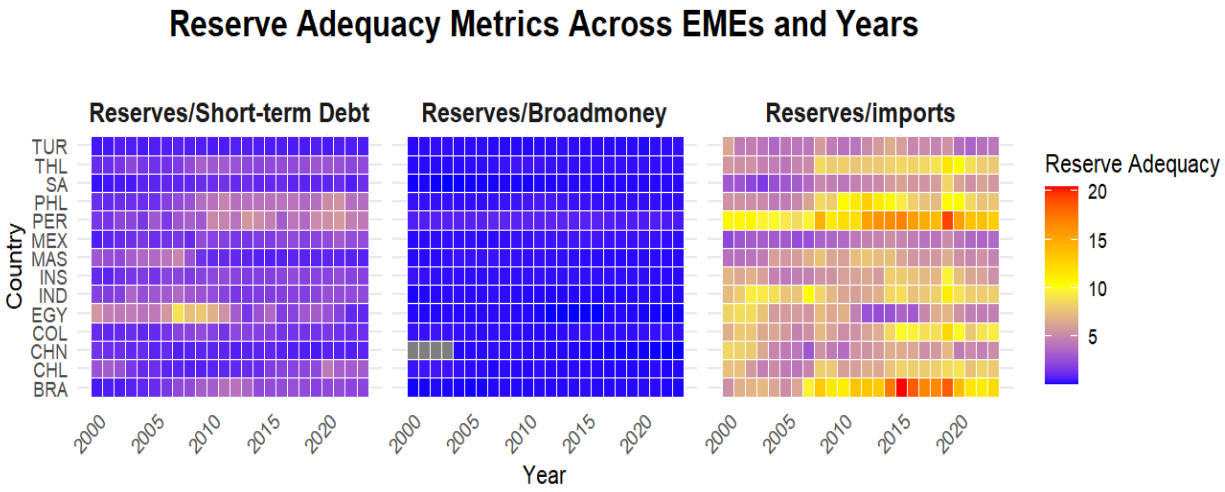
Source:IMF

This is regarded as the one of the most spectacular recent trends happening in the new international financial architecture in EMEs. The considerable built up of international reserves by EMEs has been widely observed in EMEs from late 1990s onwards. The international reserves accumulation by central banks of EMEs are used as a cushion against the external shocks originating as part of global financial integration. The role and importance of the international reserves in EMEs are believed to reduce the impact of crises and economic shocks(Mishikin,1999;Aizenman& Marion,2002 ;Frenkel,2005). Aizenman and Sun (2010) argues that many EMEs chose not to deplete their international reserves as part of their adjustment mechanism. Many EMEs that were "reserve accumulators" before the crisis used their reserves and allowed their currencies to depreciate during the crisis. Dominguez et al.(2012) find evidence of "reserve bounce back "among the EMEs where they went back to their pre-crisis reserve accumulation trends. But contrary to this argument,Eichengreen et al(2022) argues that the central banks have accumulated substantial portfolios of financial assets. When the reserves exceed the level associated with reserve adequacy, reserve managers come to distinguish different reserve tranches: the minimum required for reserve adequacy the "liquidity tranche", which should be held in liquid, low-risk assets; and the rest the "investment tranche". This development has not come to an end, but, on the contrary, has accelerated sharply since the East Asian financial crisis. Since 1996 the level of reserves has almost tripled. The accumulation of international reserves has increased over the years globally. After the Global Financial Crisis(GFC),the international reserves are skyrocketing in EMEs.The role of international reserves holdings has been well documented in the theoretical as well as in empirical literature. They play significant role in stabilizing balance of payment mismatches, exchange rates and reducing the impact of unanticipated emergencies and economic shocks. The holdings of international reserves have reached record -breaking levels in many EMEs.A primary distinction between the policies of central banks in developed nations and EMEs is the significant accumulation of reserves, especially following the financial crises. China, the nation with the greatest foreign exchange reserves in the world, with reserves of almost $4 trillion as of 2024.

Both theoretical and empirical evidence suggest that the EMEs has accumulated international reserves beyond the optimal level. According to Steiner(2009), just after the break-up of the Bretton Woods system, the absolute value of worldwide official reserves increased by a factor of 17.1 in 2006 (Steiner,2009). Stenier(2012) later addressed this accumulation as one puzzle of the international financial system since the demise of the Bretton Woods

system. In contrast to general wisdom, the transformation to de-jure more flexible exchange rate regimes has not been accompanied by a permanent reduction in the level of reserves. China the leading accumulator of international reserves, and one of the major EMEs holds 3380 billion in October 2024. This increase is also observable in commonly used indicators of reserve adequacy of IMF which consider the level of reserves in relation to a scaling variable like imports, GDP or external debt, especially in EMEs . This shows that the increase cannot be explained by simple rules of thumb: Whereas traditionally a level of reserves covering three to four months of imports was considered to be adequate, in 2010 reserves covered on average almost six months of imports. The heatmap given below shows the trend of reserve adequacy parameters over the years in EMEs.From the figure 2 it is clear that over the years EMEs are holding more than the adequacy level. Refer Appendix for the rule of thumb proposed by IMF.From the heatmap it is clear that over the years the EMEs are accumulating more international reserves than required.

Figure 2:Reserve Adequacy Metric in EMEs.

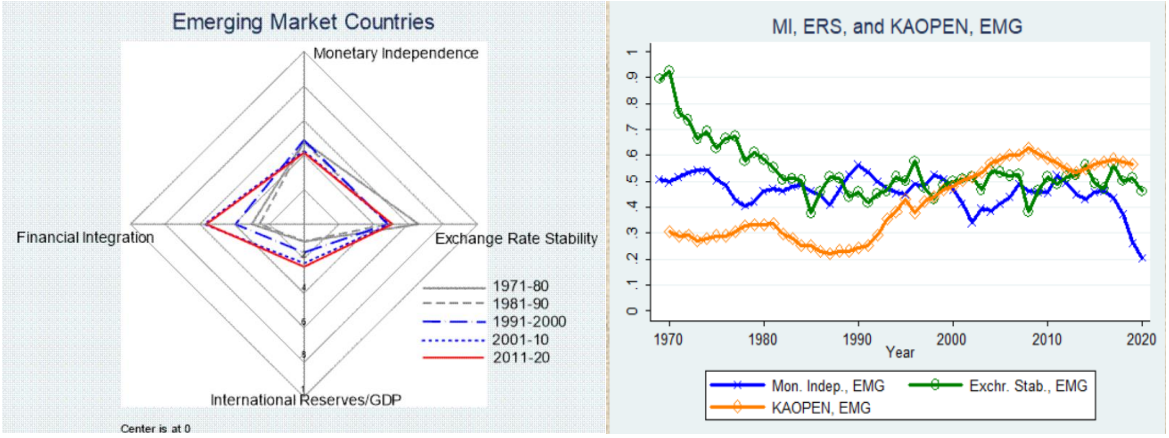


Source:IMF

But simply looking at the reserve adequacy metric will not be sufficient to explain the trend of international reserves accumulation in EMEs.There are other factors explaining this trend. More specifically, there are macro-economic determinants that determine the process of accumulation in EMEs.In the current international financial architecture ,the EMEs find difficult to achieve the policy goals of financial integration, monetary independence and exchange rate stability. There is a strand of literature identifies the importance of international reserves accumulation from policy dilemma framework in EMEs. A fundamental contribution of the Mundell–Fleming framework is the impossible trinity, or the Trilemma. The Trilemma states that a country may simultaneously choose any two, but not all of the following three policy goals ;monetary independence, exchange rate stability and financial integration(Aizeman,2013).The impossible trinity triangle is given in the Appendix for reference. Although the “impossible trinity” has become self-evident for most academic economists in practice, most countries (emerging countries) may face a challenge to achieve all of the three peaks of the Mundell triangle or at least countries are shifting their configuration to adapt to new challenges and changing economic and global structures(Mansour,2014). The below figure summarizes the changing patterns of trilemma during 1970-2020 period in EMEs.It shows that the EMEs moved towards relatively flexible exchange rate regimes, higher level of financial integration and lower monetary dependence compared to other non-EMEs.This also validates that the EMEs have moved towards a middle ground among all three indices over the years with the help of accumulation of international reserves. This is because of the fact that the actual choice of trilemma configuration depends upon the challenges and priorities of an economy(Aizeman,2013).But pertinent developments that modify the context of trilemma configuration are the massive financial globalization happened in EMEs from 1990s onwards. Pursuing financial integration while maintaining financial stability of EMEs may explain intriguing developments

in the three decades since the 1980s despite the proliferation of greater exchange rate flexibility, international reserves/GDP ratios increased substantially. Most of the increase in reserve holding has taken place in EMEs added the fourth dimension to the trilemma framework. These international reserves have important roles in relaxing the trilemma and makes impossible trinity possible. This is one of the major changes happening in the financial architecture of EMEs. This evidence is consistent with the view that countries' efforts to "relax the Trilemma" in the short-run can involve an increase in international reserves holding [Aizenman et al. (2011);Aizenman and Ito (2012). An economy can achieve a targeted combination of sovereign monetary policy,stable exchange rate system and capital account openness, with an adequate amount of IR hoardings. While they cannot make the trilemma fully achievable, they provide the flexibility needed to navigate external shocks, stabilize exchange rates, and maintain some degree of monetary independence or capital mobility. Aizenman &Ito (2011) have found that the trinity policy choices of the emerging economies have started converging towards the middle grounds with the help of their buffers of IR. The convergence of three polices over the in each EME are depicted in the figure 7 given in the Appendix. Although empirical studies of Bubula & Otker-Robe (2003) shows that intermediate solution is vulnerable to financial crisis, focused on the advantage and cost of every corner solution especially in EMEs after 90s financial crisis, he concludes that a corner solution would not be preferable, but an intermediate regimes seem to be a better solution (Allegret 2007), especially for emerging countries where their structural characteristics are: debts, external debts (in foreign currencies) and financial vulnerability; (Allegret 2005)). This is known as the "quadrilemma framework" and which is very evident in EMEs. This may indicate that holding a high volume of international reserves may give room to emerging market economies to choose a policy combination from a wider spectrum of policy combinations compare to industrial countries(Aizeman &Ito,2011).Such convergence occurs when the trade-off among the three components of a trilemma (monetary independence, exchange rate stability and financial openness) or an impossible trinity is minimized(Law,2017).Thus they all acknowledged the importance of holding international reserves in EMEs in impossible trinity framework. But these international reserves are determined by certain variables more importantly macro-economic variables. By acknowledging the importance of holding international reserves in policy trilemma situation, it is equally important to identify the major determinants which motivate the EMEs to hold international reserves.

Figure 3 :Impossible Trinity becomes Possible in EMEs



Source:https://web.pdx.edu/~ito/trilemma_indexes.

Given the pressing concern of the growing reserve holdings of central banks in EMEs, this study contributes to the existing literature in multiple ways. Firstly, the present work is able to explain the relationship between international reserves and its major macro-economic determinants EMEs in the context of current international financial architecture and impossible trinity framework. Although numerous studies have attempted to identify and unravel the relevance of these factors, the debate on the determinants of international reserves are far from settled especially in EMEs context(Cheung &Ito,2009).The literature in determinants of international reserves are mostly country specific studies(Adhikari(2018), John and Sethi(2020), Suman(2021),etc. There are few studies concentrating in EMEs,but ignoring the fact of finding individual specific features and dynamics(Aizenman and

Marion (2002, 2004) Gosselin& Parent, (2005).Secondly, departing from the earlier studies, this study employs bootstrap ARDL approach proposed by McNown et al.(2018) to examine the relationship between holdings of international reserves and its determinants. This method has several advantages over traditional ARDL methodology by Pesaran et al(2001) to generate respective critical values based on each data integration property. The bootstrap ARDL approach offers several advantages over the traditional ARDL model, making it a powerful tool for studying the determinants of international reserves. Unlike standard ARDL, which relies on asymptotic theory and often produces unreliable inference in small samples, the bootstrap ARDL method provides more accurate critical values and confidence intervals by empirically generating them through resampling. Many empirical studies have drawn their conclusions of cointegration based solely on the F test of lagged variables and t test of the lagged level of independent variable. But they neglect to perform the second test ,which is the t test on the coefficient of the lagged level of dependant variable(eg.Baek.2016).This enhancement is particularly beneficial for studies using small or limited datasets, common in macroeconomic research, where inference precision is crucial.

2.0 Review of Literature

The frequent occurrences of the crises in EMEs have highlighted the importance of holding the international reserves for coping with massive capital outflows and external shocks. This has paved the way for EMEs to hold the international reserves, intriguing many researchers and policymakers to carry out empirical examinations regarding the determinants of international reserves in changing international financial architecture context. The issue surrounding the determinants of foreign reserves has been extensively discussed in both theoretical and empirical literatures, whether on time-series, panel or cross-country comparative basis.

Cabezas, L., & De Gregorio, J. (2019) in their paper argued that the EMEs during 2000s were characterized by massive accumulation of international reserves. It is a key feature of the global landscape. Feldstein (1999) argued that the accumulation of foreign reserves was an insurance against sudden stops of capital inflows and capital outflows in EMEs.Aizenman and Marion (2002) investigated the rationale behind the differences in the level of demand for international reserves held by developing countries, using a sample of 125 developing countries. Their empirical findings suggest that international reserve holdings are majorly influenced by factors such as the size of international transactions, exchange rate volatility and political considerations.Bussière et al (2015) claimed that it is the protection during crisis is the major factor determining the accumulation of international reserves. They argued through empirical results and found that the countries suffered less when they hold huge number of international reserves. Steiner (2013) in his research article, strongly points that it is because of the capital market liberlisation,the accumulation of reserves is high in EMEs.There are numerous studies(Country specific and Group specific) conducted in identifying the determinants of international reserves using empirical models. The summary of empirical literature happened so far are listed in the table below.

2.1 Empirical literature

The summary of empirical literature in determinants of international reserves are given in the table below.

Table 1 : Summary of Empirical Literature in Determinants of International Reserves

Author(s)	*Context of the study*	*Time Period*	*Methodology*	*Determinants*
Foo.et.al(2023)	Developing Countries	2003-2015	Panel: Static linear panel Regression	Exchangerate,Trade,Money suppy,Interest rate
Meyer.et.al(2019)	Southern African Countries	1990-2015	Panel ARDL	FDI,Exports,imports,inflation and exchange rate
Fasanya& Thabana(2024)	Sub-saharan African Countries	2000-2019	Panel ARDL	Trade openness, broad money to GDP, Inflation, exchange rate.Political stability and absence of terrorism, government effectiveness, control of

				corruption and voice and accountability
Fouquau& Delatte(2009)	Emerging Market Economies	1980-2004	panel smooth transition model	Population, Short-term debt, Terms of Trade, Imports to GDP ratio and Exchange rate volatility
Bada et al(2022)	OPEC countries	2005 - 2018	System generalised methods of moments (Sy-GMM) through fixed and random effects (FE and RE)	Economic or financial crises index, exchange rate (NEER), inflation rate, gross domestic product (GDP), FDI,crude oil price, economic openness,and natural resource dependence
Suleymanli(2022)	G-7 Countries	1971-2020	GMM	FDI.CPI.Exchnage rate,Inflation
Individual countries				
Jena &Sethi(2020)	Brazil	1960-2018	Time series:ARDL	Exchange rate,Inflation,per capita GDP,Current account balance,Debt to GDP
Prabheesh et al(2007)	India	1983-2005	Time series: Co-integration	Exchange rate, broad money to GDP, Interest rates
Abhu-Amasiet al(2022)	Nigeria	1970-2016	Error Correction Methodology	Trade openness, Exports
Islam(2020)	Bangladesh	1994-2016	Johansen co-integration	Broad money, exchange rate ,Interest rate, GDP
Banchuenvijit(2014)	Thailand	2008-2011	Multiple regression with OLS	Tradebalance,exchange rate,GDP,Propensity to import
Nikolov & Sulejmani	Macedonia	2004-2016	OLS	GDP,intersrt rate,exchange rate,Exports
Shevchuk(2015)	Ukraine	2000-2014	Multivariate ECM	Imports,Money stock,Exchange rate
Misztal(2021)	China	1990-2019	OLS	FDI,Debt,Imports,Money supply
Ellis &Nechi(2008)	Mexico	1985-2006	OLS	GDP,capital flows,Imports,Exchange rate

These are the important studies in identifying the empirical determinants of international reserves in countries and group of countries. Most of the studies validates that the international reserves are mostly determined by macro-economic factors.These determinants can be classified into trade related determinants, policy related determinants, foreign exchange market related determinants, growth related determinants ,capital account related determinants and political-institutional related determinants. But this study mainly focuses on the macro-economic determinants which include trade related determinants, policy related determinants, foreign exchange market related determinants, growth related determinants and capital account related determinants. These are relevant for EMEs context as well. Thus, the present study contributes to the literature in flowing ways.First,all of these existing studies have highlighted the importance of finding determinants of international reserves. But there is a significant gap in addressing the macro-economic determinants of international reserves in EMEs with accommodating current international financial architecture.Second,this study takes into account major determinants of international reserves in EMEs and employ bootstrap ARDL method to find the relationship between them. The studies used traditional ARDL methods suffers from disadvantages as mentioned earlier.Also,this study analyses each EME in detail to know the relationship between international reserves and its macro-economic determinants Bootstrap autoregressive distributed lag (ARDL) test for cointegration and causality (McNown et al., 2018) is a new method and more powerful than the traditional ARDL model (Pesaran et al., 2001) in the following aspects:

1. With the new test on the lagged level(s) of the independent variable(s), we can better identify the cointegration, non-cointegration or a degenerate case.

2. The bootstrap ARDL test could eliminate inconclusive inferences with the bounds test.

3. The bootstrap ARDL model allows for the endogeneity and feedback that may exist among the variables.

Last but not least, equipped with the new approach and the most updated data, the paper investigates both the long-run and the short-run nexus between international reserves and its determinants in EMEs ,which is rarely studied in the literature. To the best of my knowledge, this study is the first paper to explore the relationship between international reserves and its determinants in EMEs using bootstrap ARDL test.By employing this methodology, the policymakers can appropriate reserve management strategies in EMEs in the context of changing international financial architecture.

3.0 Data and Methodology

The estimation is based on 14 EMEs from 1991-2022. The primary sample included 20 emerging economies to be consistent with the estimations IMF(2021)[2].These 20 emerging market countries account for 34 percent of the world's nominal GDP in US dollars and 46 percent in purchasing-power-parity terms. These countries are also featured in commonly used indices for emerging markets, such as those of J.P. Morgan, Morgan Stanley Capital International, and Bloomberg. However, we dropped six countries due to lack of data. The remaining 14 countries are Brazil, Chile, China, Colombia, Egypt ,India, Indonesia, Malaysia, Mexico, Peru, Philippines, South Africa, Thailand, and Turkey.Data are obtained from World Bank,IMF and Central bank websites of the respective countries.Figure1 presents international reserves holdings since 1991 of the 14 EMEs included in our sample.

Figure 4:Internatioanl Reserves Accumulation in EMEs

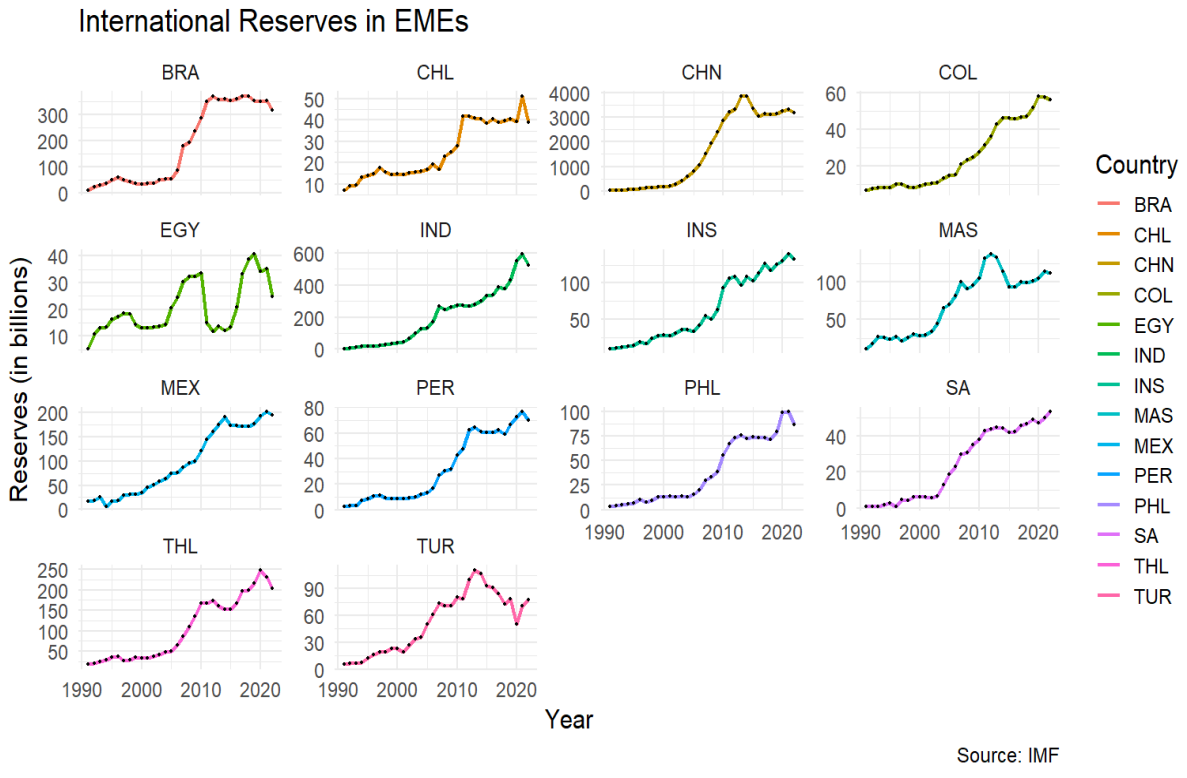


Figure 1:Accumulation of International Reserves in EMEs

[2] This approach identifies the following countries in the emerging market group, in alphabetical order: Argentina, Brazil, Chile, China, Colombia, Egypt, Hungary, India, Indonesia, Iran, Malaysia, Mexico, the Philippines, Poland, Russia, Saudi Arabia, South Africa, Thailand, Turkey, and the United Arab Emirates.

3.1*Data and explanatory variables*

The focus of the study is the investigation of macro-economic determinants of international reserves among EMEs.The literature is replete with a number of macro-economic variables that significantly influence international reserves in EMEs.In this paper we have taken the major macro-economic determinants such as inflation(policy factor), exchange rate(Foreign exchange market factor),current account balance(Trade related factor),foreign direct investment(Capital account related factor) and GDP(Growth factor) based on their and data availability . These variables are relevant for EMEs context. The below table gives an idea about the sources of the variable taken for the study. For this study, we use the log forms for only international reserves and GDP, since the rest of the variables are expressed as percentages.

Table2:Variables and Data Sources

Variable	*Description*	*Unit of measurement*	*Source*
Dependent Variable *International Reserves*	Total International Reserves including gold	Current US $	IMF,WDI
Independent Variables/Explanatory variables			
Exchange Rate	Official exchange rate	LCU per US$, period average	WDI
Inflation	Inflation	Annual %	WDI
FDI	Foreign Direct investment	% of GDP	WDI
CAB	Current Account Balance	% of GDP	WDI
GDP	Nomina GDP	Current US$	WDI

3.3 Methodology

This study is investigated the macro-economic determinants of international reserves in EMEs during the period of 1991-2022. It implies the bootstrap test statistics through ARDL methods for the specification of dynamic single-equation error correction. However, Pesaran et al. (1999, 2001), Pesaran & Pesaran (1997) and Pesaran & Smith (1995), established ARDL framework to identify the relationship among variables.But in order to know the power and size properties of the variables in the model, McNown et al. (2016) adapted bootstrap methods with cointegration of ARDL tests. The bootstrap ARDL model is used to make their critical values to overcome the narrow statistical method by Pesaran et al. (2001). This particular bootstrap test used for empirical data and precise models with less than any series of integration properties. However, this bootstrap ARDL test has one unique quality as compared to other bound tests; it eradicates the possibility of indeterminacy. This method is also suitable for the small samples. Furthermore, this bootstrap test generates the critical values from given empirical data, which lies from specific to integration properties, in that particular process of generating critical values, it eliminates the possibility of indeterminacy values (Saleem et al. (2019).The bootstrap ARDL test has an added advantage that it measures accelerate for those models, who has more than one endogenous variable in their models McNown et al. (2016).Thus, this study employs bootstrap test statistics from a dynamic single-equation error correction specification of the autoregressive distributed lag model. They also suggested an additional test on the lagged independent variables to complement the existing F and t tests for cointegration proposed by Pesaran et al. (2001). The use of all three tests is necessary to distinguish between cases of cointegration and non-cointegrating degenerate cases as defined by Pesaran et al. (2001).

In general, a three-variable ARDL (a,b,c) can be written as:

$$x_t = \sum_{i=1}^{a} \alpha_i x_{t-i} + \sum_{j=0}^{b} \beta_j y_{t-i} + \sum_{k=0}^{c} \gamma_k z_{t-k} + \sum_{l=1}^{q} \delta_l D_{t,l} + \mu_t \quad (1)$$

Where i,j,k and l denote lags ;i=1,2,3…..,a ;j=0,1,2,……b; k= 0,1,2…..c; q=1,2,…..l ;t indicates the time periods t=1,2,……T; x_t is the dependant variable and z_t are explanatory variables and $D_{t,k}$ is a dummy variable. β_j and γ_k are the coefficients on the lags of the explanatory variables and α_i are the coefficients of the lags of dependant variable ; δ_l is the coefficient of the dummy variable and μ_t is the iid with zero mean and finite variance.

This equation (1) can be reshaped and expressed in an error correction representation as ;

$$\Delta x_t = \varphi x_{t-1} + \omega y_{t-1} + \rho z_{t-1+} \sum_{i=1}^{a-1} \tau_i \Delta x_{t-i} + \sum_{j=1}^{b-1} \varepsilon_j \Delta y_{t-i} + \sum_{k=1}^{c-1} \pi_k \Delta z_{t-k} + \sum_{l=1}^{q} \theta_l D_{t,l} + \epsilon_t \quad (2)$$

Where φ = - [1-$\sum_{i=1}^{a} \alpha_i$] ; $\omega = \sum_{j=0}^{b} \beta_j$; $\rho = \sum_{k=0}^{c} \gamma_k$; and τ_i , ε_j , π_k and θ_l are functions of the original parameters in the Eq.1.Pesaran et al(2001) argue that the co-integration test should be F test or t test.

$H_0 = \theta_1 = \theta_2 = \theta_3 = 0$ or $\theta_1 = 0$

McNown et al(2016)has proposed adding the original ARDL model to a lag period for independent variables where the null hypothesis is $\theta_2 = \theta_3 = 0$.This will create more complete conditions for testing the co-integration relationship proposed by Pesaran et al(2001).Then the following null hypotheses should be rejected:

- The null hypothesis of the error term F_1 is tested as $H_0 : \theta_1 = \theta_2 = \theta_3 = 0$
- The t test of the lag dependant variable is $H_0 : \theta_1 = 0$
- The F_2 test for the lag independent variable is $H_0 : \theta_2 = \theta_3 = 0$

McKnown.et.al(2016) in their paper argues that co-integration among x_t,y_t and z_t requires rejection of all three-null hypothesis. The F values (as F1) is related to the error correction terms, and F values (as F2) used for lagged independent variables are and t (t*) indicates the significant t statistics for the coefficient lagged dependent variable. Here two degenerate cases can arise.

The degenerate case # 1 occurs when F_2 is insignificant, but t and F_1 are significant. In this case the joint significance of the error correction terms is solely due to the lag of the dependant variable where explanatory variables are not part of the long run cointegration.

The second case which is degenerate case #2 happens when F_1 and F_2 are significant but t is not at all significant. The bootstrap procedure will give critical values for all three tests as compared to Pesaran et al(2001) where they provide critical values for F_1 and t tests. Thus, by providing critical values for all three tests, the bootstrap ARDL eliminated the possibility of indeterminacy exists in the bound test.Another advantage of this methodology is that it is an appropriate for models with more than one endogenous variable.Pesaran et al(2001) developed critical value bound tests by imposing strict exogeneity of the explanatory variables, inappropriate for macro-economic relations. This paper employs ARDL methodology to analyse the relationship between determinants of international reserves in EMEs context. In this context, the ARDL representation is specified as follows;

$$\Delta lnre_t = \delta + \sum_{i=1}^{j} \beta_i \Delta lnre_{t-i} + \sum_{i=0}^{k} \alpha_i \Delta ex_{t-i} + \sum_{i=0}^{l} \pi_i inf_{t-i} + \sum_{i=0}^{m} £_i \Delta fdi_{t-i} + \sum_{i=0}^{n} \Omega_i \Delta cab_{t-i} + \sum_{i=0}^{p} \tau_i \Delta lnGDP_{t-i} + \sum_{i=0}^{r} \vartheta_i \Delta D_{t-i} + \varphi_1 lnre_{t-i} + \varphi_2 ex_{t-1} + \varphi_3 inf_{t-1} + \varphi_4 fdi_{t-1} + \varphi_5 cab_{t-1} + \varphi_5 \ln GDP_{t-1} + \varphi_6 D_{t-i} + \varepsilon_t \quad (3)$$

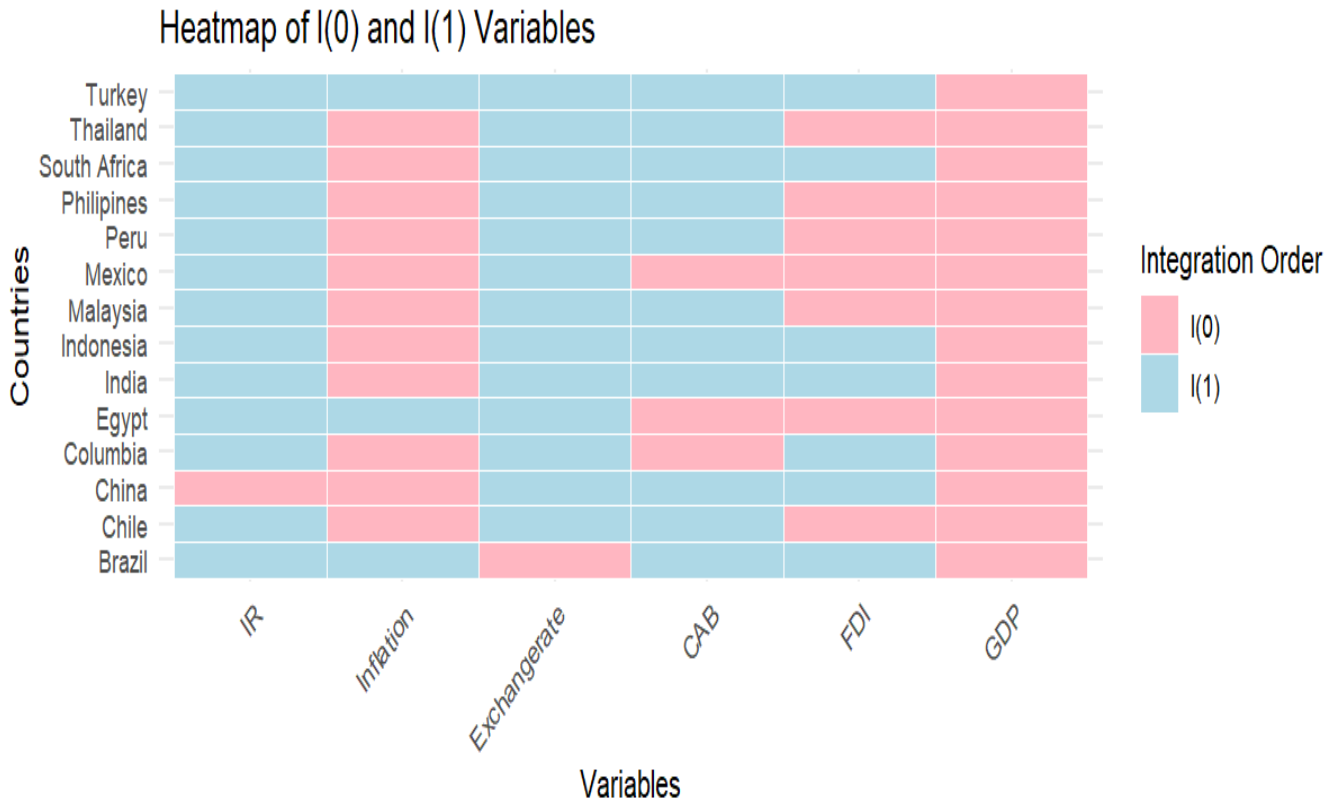
where $lnre_t$ is the natural log of international reserves, ex_t is the exchange rate, inf_t is inflation, fdi_t is the foreign direct investment, cab_t is the current account balance ,$lnGDP_t$(natural log of GDP) and ε_t the residual term, which is assumed to be white noise.Dummy variables are also included in this model to distinguish crisis and non-crisis periods in EMEs.In Eq.(3), δ denotes the intercept ,whereas β,α,π,€,Ω, τ and ϑ are short-run coefficients and φ_i(i=1,2,3,4,5,6) depicts long-run estimates.In addition,j,k,l,m and n denote lag order.We have taken lag one as per AIC criteria and Final prediction error for the analysis .since it is an annual data, lag one is an appropriate lag(Wooldridge,1996).

4.0 Results and Discussion

4.1 Unit root Testing

In the first step ,we examine the unit root property of the variables. Given that the reliability of co-inegration analysis relies on the stationarity of the series, the study conducts unit -root tests. Results from the Augmented Dickey-Fulller (ADF) test is given below. Due to space consideration,heatmap of ADF results are given below.

Figure 5:Summary of ADF unit root Resulta



The heatmap indicates that all the data series are integrated at level or first difference. To conduct bootstrap ARDL model, all variables must be integrated at level or first difference. As the analysis of unit root fulfil the requirement, bootstrap ARDL can be employed.

4.2 Co-integration Testing

This step explores the co-integration(long-run relationship) of determinants of international reserves in EMEs context.To know the co-integration between international reserves and its macro-economic determinants in all EMEs together ,we have tested panel cointegration test proposed by Westerland(2007).The result of the test in given below.

Table 3:Panel co-integration Summary

	Statistic	p-value
Variance Ratio	2.1884	0.0143

Here the null hypothesis is there is no cointegration (no long-run relationship) in the panel, and the alternate hypothesis is some panels (or units) are cointegrated. Since p value is 0.0143 which is less than 5% level we reject

the null hypothesis and conclude that some panel are co-integrated. So now we extend the literature by testing EMEs one by one for knowing the kind of relationship between international reserves and its macro-economic determinants in detail. For that purpose ,we have conducted individual time series analysis using Bootstap ARDL method. This will give us an idea about the co-integration of international reserves and macro-economic determinants in each country and we can conclude whether there is a long-run relationship exists or not.In bootstrap ARDL method,it is worth mentioning that the co-integration exists only if the calculated values of F-test(Overall),t test(depenadenat variable) and F-test(Independent) are greater than the critical values. The international reserves are treated as the dependent variable in the ARDL equation for renormalization the model. In addition, dummies are added in the model as EMEs go through multiple crisis periods.Moreover, different years of dummies such as D08 indicate the dummy for the year of 2008 and D01 for the year 2001.

Table 2 below shows co-integration summary from the bootstrap ARDL bounds test.From the table, it is clear only Egypt depicts long-run relationship between international reserves and its macro-economic determinants. It indicates in almost all EMEs there is no long -run relationship between international reserves and its determinants. Thus in EMEs,relationship among international reserves and its macro-economic determinants are more short-run phenomenon than long-run phenomenon.

Table 4 :Co-integration Summary(Bootstrap ARDL)

Country	F_1	$F_1^{Critical}$	F_2	$F_2^{Critical}$	t	$t^{Critical}$	Dummy Variables	Result
Brazil	10.63	9.213	11.79	10.378	-3.095	-3.341	D99,D08,D14,D15,D16,D20.D21	Degenerate case#2
Chile	3.730	8.089	4.459	9.139	-4.359	-5.553	D08,D20,D21	No cointegration
China	3.337	7.136	3.655	7.992	2.696	0.037	D97,D98, D08,D20,D21	No cointegration
Columbia	3.217	5.028	3.798	4.992	-2.118	-3.181	D99, D08,D20,D21	No cointegration
Egypt	5.569	5.524	5.116	4.401	-4.33	-3.798	D08,D11,D13,D16,D20,D21	Cointegration
India	4.762	4.773	5.067	4.631	-1.332	-2.183	D91, D97,D98, D08,D20,D21	No Cointegration
Indonesia	2.875	4.110	3.123	4.421	-2.612	-2.987	D97,D98, D08,D13,D20,D21	No-Cointegration
Malaysia	2.385	4.671	2.785	5.158	-1.304	-2.351	D97,D98, D08,D13,D20,D21	No-Cointegration
Mexico	1.608	3.654	1.566	3.234	-0.426	-1.605	D94,D08,D20,D21	No Cointegration
Philipines	2.918	6.232	2.702	4.781	-2.119	-2.746	D91, D97,D98, D08,D20,D21	No-Cointegration
Peru	4.668	7.623	5.601	8.665	-2.095	-4.170	D08,D20,D21	No-cointegration
Thailand	1.349	6.187	1.220	5.554	-0.498	-2.969	D91, D97,D98, D08,D20,D21	No-cointegration
Turkey	5.491	15.32	4.873	13.63	-2.127	-3.497	D94,D01,D08,D18,D20,D21	No-cointegration
South Africa	3.634	7.841	3.690	7.103	-4.360	-5.428	D01, D08,D18,D20,D21	No-cointegration

4.3 Short-run and Long-run estimates from Bootstrap ARDL Model

In this section, the study renders the short-run and long -run estimates from bootstrap ARDL model. The below table shows the short-run and long-run estimates of bootstrap ARDL model in each EME.This will help us to get an idea about whether these determinants are significantly affecting international reserves in each country and the which determinants are commonly important for EMEs.The results are given below.

Table 5:Bootstrap ARDL Short-run and Long-run Coefficients

Brazil		
Long-run coefficients		
Variable	Coefficient	Probability value

Lnreserves(-1)	-0.566	0.006*
Exchange rate	-0.857	0.059*
Exchange rate(-1)	-0.485	0.0026**
CAB	0.003	0.956
CAB(-1)	0.0018	0.956
fdi	-0.208	0.049**
fdi(-1)	-0.118	0.016*
inflation	-0.0005	0.223
Inflation(-1)	-0.0003	0.106
GDP	0.468	0.598
GDP(-1)	-0.265	0.546
Dummy Brazil	-0.0500	0.541
Short-run Coefficients		
ΔExchange rate	-0.0071	0.935
Δ CAB	0.029	0.143
Δ fdi	-0.024	0.390
Δ inflation	-0.0002	0.0026**
Δ GDP	0.631	0.0037**
ECT	-0.56	0.000***

Chile		
Long-run coefficients		
Variable	Coefficient	Probability value
Lnreserves(-1)	-0.907	0.0014**
Exchange rate	0.00053	0.857
Exchange rate(-1)	0.00048	0.859
CAB	-0.051	0.000***
CAB(-1)	-0.046	0.003**
fdi	0.007	0.481
fdi(-1)	0.006	0.474
inflation	-0.028	0.042**
Inflation(-1)	-0.025	0.038**
GDP	0.640	0.0000***
GDP(-1)	0.581	0.002**
Dummy Chile	0.063	0.372
Short-run Coefficients		
ΔExchange rate	0.0018	0.023**
Δ CAB	-0.03	0.000***
Δ fdi	0.007	0.221
Δ inflation	-0.036	0.000***
Δ GDP	1.554	0.0003**
ECT	-0.97	0.0000***

China		
Long-run coefficients		
Variable	Coefficient	Probability value
Lnreserves(-1)	0.338	0.0010**
Exchange rate	-0.635	0.003**
Exchange rate(-1)	0.214	0.007**
CAB	0.051	0.446*
CAB(-1)	-0.0175	0.368
fdi	-0.037	0.790
fdi(-1)	0.012	0.806
inflation	-0.079	0.002**
Inflation(-1)	0.026	0.07*
GDP	0.1.10	0.000***
GDP(-1)	-0.372	0.007**

Dummy China	0.076	0.389
Short-run Coefficients		
ΔExchange rate	0.222	0.001***
Δ CAB	-0.013	0.453
Δ fdi	0.022	0.600
Δ inflation	0.032	0.013
Δ GDP	-0.390	0304
ECT	0.33	0.0001***

Columbia		
Long-run coefficients		
Variable	Coefficient	Probability value
Lnreserves(-1)	-0.305	0.051*
Exchange rate	-0.0002	0.014**
Exchange rate(-1)	-0.00007	0.190
CAB	0.077	0.126
CAB(-1)	0.023	0.027**
fdi	-0.099	0.135
fdi(-1)	-0.030	0.062*
inflation	0.031	0.045**
Inflation(-1)	0.009	0.193
GDP	1.462	0.0000***
GDP(-1)	-0.447	0.034**
Dummy Columbia	-0.0017	0.77
Short-run Coefficients		
ΔExchange rate	-0.0002	0.0004***
Δ CAB	-0.0001	0.980
Δ fdi	0.002	0.763
Δ inflation	0.0015	0.073**
Δ GDP	-0.228	0.207*
ECT	-0.305	0.001***
Egypt		
Long-run coefficients		
Variable	Coefficient	Probability value
Lnreserves(-1)	-0.609	0.0006***
Exchange rate	0.072	0.004***
Exchange rate(-1)	0.044	0.0013***
CAB	-0.036	0.193
CAB(-1)	-0.022	0.237
fdi	0.102	0.003***
fdi(-1)	0.062	0.003***
inflation	-0.004	0.264
Inflation(-1)	-0.002	0.286
GDP	-0.338	0.078*
GDP(-1)	-0.206	0.067*
Dummy Egypt	0.011	0.903
Short-run Coefficients		
ΔExchange rate	0.050	0.053*
Δ CAB	-0.020	0.258
Δ fdi	0.0191	0.334
Δ inflation	-0.0013	0.468
Δ GDP	0.09	0.825
ECT	-0.60	0.000***

India		
Long-run coefficients		
Variable	Coefficient	Probability value
Lnreserves(-1)	-0.275	0.014*
Exchange rate	-0.147	0.008*
Exchange rate(-1)	-0.040	0.0023***
CAB	0.253	0.056*
CAB(-1)	0.0700	0.089*
fdi	-0.085	0.705
fdi(-1)	-0.023	0.694
inflation	-0.099	0.172
Inflation(-1)	-0.0275	0.014*
GDP	-0.828	0.483
GDP(-1)	-0.228	0.633
Dummy India	0.0183	0.789
Short-run Coefficients		
ΔExchange rate	-0.014	0.207
Δ CAB	0.103	0.000***
Δ fdi	-0.0777	0.027*
Δ inflation	-0.009	0.125
Δ GDP	0.509	0.259
ECT	-0.27	0.000***

Indonesia		
Long-run coefficients		
Variable	Coefficient	Probability value
Lnreserves(-1)	-0.425	0.033**
Exchange rate	-0.0002	0.594
Exchange rate(-1)	-0.00001	0.529
CAB	0.091	0.060*
CAB(-1)	0.039	0.019**
fdi	-0.065	0.430
fdi(-1)	-0.027	0.437
inflation	0.025	0.059*
Inflation(-1)	0.010	0.014**
GDP	1.35	0.002**
GDP(-1)	0.577	0.005**
Dummy Indonesia	-0.122	0.02**
Short-run Coefficients		
ΔExchange rate	0.00075	0.059*
Δ CAB	0.043	0.0003**
Δ fdi	0.0003	0.986
Δ inflation	0.007	0.006***
Δ GDP	-0.121	0.677
ECT	-0.42	0.001***

Malaysia		
Long-run coefficients		
Variable	Coefficient	Probability value
Lnreserves(-1)	-0.262	0.1632
Exchange rate	-0.220	0.3186
Exchange rate(-1)	-0.057	0.386
CAB	0.061	0.060*
CAB(-1)	0.016	0.009***
fdi	0.356	0.240

fdi(-1)	0.093	0.0027***
inflation	-0.328	0.2454
Inflation(-1)	-0.0864	0.015**
GDP	0.978	0.000***
GDP(-1)	0.257	0.1660
Dummy Malaysia	-0.161	0.026**
Short-run Coefficients		
ΔExchange rate	-0.396	0.0050***
Δ CAB	0.0299	0.0000***
Δ fdi	0.055	0.0010***
Δ inflation	-0.040	0.0034
Δ GDP	-0.540	0.116
ECT	-0.262	0.0000***

Mexico		
Long-run coefficients		
Variable	Coefficient	Probability value
Lnreserves(-1)	-0.642	0.1983
Exchange rate	-0.187	0.254
Exchange rate(-1)	-0.120	0.139
CAB	0.140	0.280
CAB(-1)	0.090	0.11
fdi	0.299	0.2512
fdi(-1)	0.192	0.267
inflation	-0.008	0.753
Inflation(-1)	-0.0054	0.773
GDP	-0.484	0.754
GDP(-1)	-0.311	0.704
Dummy Mexico	-0.319	0.075*
Short-run Coefficients		
ΔExchange rate	-0.0031	0.968
Δ CAB	0.090	0.044**
Δ fdi	0.1100	0.108
Δ inflation	-0.0003	0.805
Δ GDP	0.794	0.289
ECT	-0.642	0.0021***

Peru		
Long-run coefficients		
Variable	Coefficient	Probability value
Lnreserves(-1)	-0.168	0.013**
Exchange rate	-1.370	0.0345**
Exchange rate(-1)	-0.230	0.0062***
CAB	-0.104	0.153
CAB(-1)	0.0176	0.125
fdi	-0.022	0.329
fdi(-1)	-0.003	0.867
inflation	-0.024	0.329
Inflation(-1)	-0.004	0.374
GDP	1.140	0.000***
GDP(-1)	0.192	0.005***
Dummy Peru	0.104	0.140
Short-run Coefficients		
ΔExchange rate	-0.297	0.0064***
Δ CAB	0.0241	0.0078***

Δ fdi	0.032	0.008***
Δ inflation	-0.003	0.000***
Δ GDP	0.666	0.002***
ECT	-0.16	0.0000***

Philipines		
Long-run coefficients		
Variable	Coefficient	Probability value
Lnreserves(-1)	-0.214	0.045**
Exchange rate	-0.003	0.854
Exchange rate(-1)	-0.0006	0.851
CAB	0.172	0.046**
CAB(-1)	0.0370	0.0100***
fdi	0.248	0.239
fdi(-1)	0.053	0.168
inflation	0.118	0.359
Inflation(-1)	0.118	0.359
GDP	0.957	0.000***
GDP(-1)	0.205	0.041**
Dummy Philipines	-0.219	0.018**
Short-run Coefficients		
ΔExchange rate	-0.055	0.001***
Δ CAB	0.0135	0.086*
Δ fdi	-0.0056	0.818
Δ inflation	0.034	0.0012***
Δ GDP	-1.96	0.002***
ECT	-0.214	0.000***

Thailand		
Long-run coefficients		
Variable	Coefficient	Probability value
Lnreserves(-1)	0.043	0.693
Exchange rate	-0.190	0.650
Exchange rate(-1)	0.008	0.246
CAB	-0.352	0.693
CAB(-1)	0.0152	0.023**
fdi	1.134	0.675
fdi(-1)	-0.048	0.143
inflation	-0.623	0.662
Inflation(-1)	0.026	0.226
GDP	1.280	0.068*
GDP(-1)	-0.055	0.617
Dummy Thailand	0.208	0.05**
Short-run Coefficients		
ΔExchange rate	0.052	0.0103**
Δ CAB	0.020	0.005***
Δ fdi	-0.033	0.025***
Δ inflation	-0.003	0.659
Δ GDP	2.71	0.000***
ECT	0.043	0.001***

Turkey		
Long-run coefficients		
Variable	Coefficient	Probability value

Lnreserves(-1)	-0.388	0.022**
Exchange rate	0.095	0.1034
Exchange rate(-1)	0.037	0.230
CAB	-0.106	0.094*
CAB(-1)	-0.041	0.028**
fdi	-0.019	0.831
fdi(-1)	-0.007	0.830
inflation	0.046	0.045**
Inflation(-1)	0.0179	0.0001***
GDP	0.136	0.819
GDP(-1)	0.0528	0.831
Dummy Turkey	-0.130	0.017**
Short-run Coefficients		
ΔExchange rate	-2.10	0.0000***
Δ CAB	-0.0035	0.52
Δ fdi	0.0320	0.158
Δ inflation	0.0017	0.0000***
Δ GDP	-0.834	0.0007***
ECT	-0.388	0.000***

South Africa		
Long-run coefficients		
Variable	Coefficient	Probability value
Lnreserves(-1)	-0.792	0.0006***
Exchange rate	-0.409	0.048**
Exchange rate(-1)	-0.324	0.0623*
CAB	-0.062	0.074*
CAB(-1)	-0.049	0.092*
fdi	-0.005	0.926
fdi(-1)	-0.0043	0.926
inflation	0.0257	0.433
Inflation(-1)	0.020	0.451
GDP	-1.755	0.221
GDP(-1)	-0.792	0.0006***
Dummy South Africa	0.035	0.802
Short-run Coefficients		
ΔExchange rate	0.081	0.469
Δ CAB	0.022	0.365
Δ fdi	-0.0013	0.941
Δ inflation	0.033	0.082*
Δ GDP	2.40	0.017*
ECT	-0.792	0.001***

Positive coefficient and Significant Negative coefficient and Significant

From this ,we can say that exchange rate is an important variable among macro-economic determinants of international reserves in EMEs.Out of 14 EMEs,exchange rate is significant in 13 EMEs (except Mexico).One can expect positive and negative sign for exchange rate in EMEs. According to our theoretical priors, exchange rate depreciation of a domestic currency has positive impact on foreign exchange reserves through export channel. The increase in nominal exchange rate (i.e. depreciation of the rupee) will make India s exports cheaper in the international markets (for which exports will be more) and will make EMEs imports costlier (for which imports will be less) in the domestic market. As a result, it may increase foreign exchange reserves. So, we expect the coefficients of exchange rate to be positive sign.

On the other hand, a decrease in nominal exchange rate (i.e. appreciation of rupee) will make EMEs exports costlier in the international market (for which exports will fall) and imports will be cheaper in the domestic market (for which imports will rise). So, we expect the coefficients of exchange rate to be negative sign. The coefficient of exchange rate can be +Ve /-Ve. Hence, it is an empirical examination. We believe inflation and foreign exchange reserves are negatively related. Because of inflation, the price level of a domestic country increases. Such increase in price level reduces export competitiveness of domestic products in the international market. The FDI taken as a proxy for capital inflows expects to have positive sign in EMEs. This result supports the claim of Calvo and Reinhart (2002) that "fear of floating", rather than "fear of capital flight", is the main determinant of reserves holdings, especially in emerging Asian economies and elsewhere. However, it contradicts the finding by Steiner (2013) in a large panel data analysis that foreign reserves are not only used to defend the exchange rate in time of crisis, but also to manage capital flows in periods of no economic disturbances. We get mixed results here.The growth indicator which is GDP expects to have positive relation with international reserves. This conclusion goes with the evidence provided by Dominguez et al. (2012)where they argue GDP and international holdings are positive related. The coefficient of current account balance can also negative and positive while determining international reserves. In each EME, the values of coefficient vary depend upon the structural characteristics of the economy. But we conclude that in almost all EMEs, the exchange rate and current account balance paly significant role in determining international reserves. But capital flows are less significant in EMEs ;this goes with the conclusion provided by Meyer et al(2019) in the context of south African nations. They confirm the "fear of floating" rather" fear of capital mobility" as major determinant of international reserves holding in Southern African region. This conclusion is also applicable in EMEs situation. We could find that exchange rate as the major determinant in each EME and can conclude as a common factor in all EMEs.In almost all economies this determinant becomes a major short-run determinant compared to long-run .It is positive coefficient in Chile,Egypt,Indonesia and Thailand, which indicate international reserves increase through depreciation of the exchange rate in short-run. When analysing CAB ,we can say that it is very important determinant of international reserves in short-run and long-run. In majority of the EMEs it has shown a positive coefficient ;a favourable trade balance accumulates more international reserves. Inflation shows both positive and negative relation in EMEs.The inflation and international reserves are positively related in Cloumbia,Indonesia,Philipines,Turkey and South Africa.

5.0 Conclusion and Policy recommendations

The empirical evidence from the literature has adduced several reasons for the accumulation of international reserves. The studies have highlighted the importance of international reserves in impossible trinity framework.It helps to relax the impossible trinity or policy dilemma by making it possible to achieve the middle ground in Emes. Thus, in the current international financial architecture, the international reserves play vital role especially after the frequent occurrences of the crises in Emes. But these international reserves are determined by a number of factors,mainly classified as macro-economic factors. This study finds the nature of the relationship between international reserves and its determinants in each EME.The panel co-integration test concludes that there are some panels co-integrated but not showing which are they. So, we extend the literature by finding the relationship among international reserves and its determinants in each EMEs by employing a new method; Bootstrap ARDL methodology. This methodology provides more accurate results compared to traditional ARDL methods. From the analysis we could conclude that except Egypt, all other EMEs depict no long-run relationship between the dependant and independent variables. So, we can say the relationship is a short-run phenomenon. Through measuring short-run and long -run significance of each determinant could find that exchange rate and CAB are major determinants influencing international reserves accumulation. The study would like to suggest that international reserve has a short-run relationship with its determinants ;so, this is very important in short-run. As literature acknowledged the importance of the role of international reserves in relaxing the trilemma situation faced by the EMEs ,policymakers can formulate a good mix of policies on exchange rate stability, financial integration and monetary

independence in short-run because international reserves are determined for a short-term. This will help the central banks to implement efficient reserve management policy. For future studies, further research can be extended to identifying the determinants of international reserves in a short-run perspective.

References

Abuh-Amasi, S. A., Joshua, N. J., & Onoyom, M. O. (2022). Determinants of International Reserves in Nigeria. *International Journal of Research and Innovation in Social Science*, *6*(5), 287-297.

Aizenman, J. & Marion, N. (2002). International reserve holdings with sovereign risk and costly tax collection. Retrieved September 24, 2017. https://ideas.repec.org/p/nbr/nberwo/9154.html.

Aizenman, J., Sun, Y., 2010. The financial crisis and sizable international reserves depletion: from 'fear of floating' to the 'fear of losing international reserves'? NBER Working Paper No. 15308.

Allegret J P; 2007; Quels régimes de change pour les marchés émergents ? les solutions de coins en questions ?; Original Scientific Paper, N° 4, pp 397-427

Allegret J.P ; 2005 ; Les régimes de change dans les marchés émergents, quelle perspective pour le 21ème siècle ? Vuibert Edition, Paris.

Arslanalp, S., Eichengreen, B., & Simpson-Bell, C. (2022). The stealth erosion of dollar dominance and the rise of nontraditional reserve currencies. *Journal of International Economics*, *138*, 103656.

Bubula A, Ötker-Robe I; 2002; The evolution of exchange rate regimes since 1990: evidence from de facto policies , IMF Working Paper, WP/02/155.

Bada, Oladejo Tokunbo; Adetiloye, Kehinde Adekunle; Olokoyo, Felicia Omowunmi; Ukporhe, Grace (2022) : Determinants of international reserves among Organisation of Petroleum Exporting Countries (OPEC), Comparative Economic Research. Central and Eastern Europe, ISSN 2082-6737, Lodz University Press, Lodz, Vol. 25, Iss. 3, pp. 111-133, https://doi.org/10.18778/1508-2008.25.24

Banchuenvijit, W. Determinants of International Reserves in Thailand.

Benli, M., Ekinci, A. ve Orhan, B. (2022). "The Long-Run Effect of International Reserves on Economic Growth in Developing Economies", Eskişehir Osmangazi Üniversitesi İİBF Dergisi, 17(3), 822 – 836. Doi: 10.17153/oguiibf.1145526

Bussière, M., Cheng, G., Chinn, M.D. & Lisack, N. (2015). For a few dollars more: Reserves and growth in times of crises. Journal of International Money and Finance, 52, 27-145.
Cabezas, L., & De Gregorio, J. (2019). Accumulation of reserves in emerging and developing countries: mercantilism versus insurance. *Review of World Economics*, *155*, 819-857.

Calvo, G.A. & Reinhart, C.M. (2002). Fear of floating. The Quarterly Journal of Economics, 117(2), 379-408.

Cheung, Y. W., & Ito, H. (2009). A cross-country empirical analysis of international reserves. International Economic Journal, 23(4), 447–481

Dominguez, K. M., Hashimoto, Y., & Ito, T. (2012). International reserves and the global financial crisis. *Journal of International Economics*, *88*(2), 388-406.

Feldstein M (1999) Self-Protection for Emerging Market Economies. National Bureau of Economic Research Working Paper 6907 (January)

Frankel, J. (2005). On the renminbi: the choice between adjustment under a fixed exchange rate and adjustment under a flexible rate (№w11274). National Bureau of Economic Research. Retrieved September 16, 2017. http://www.nber.org/papers/w11274.

Foo Y.S., Chin L., Chen K.S., Allayarov P. (2023). The determinants of international reserves in developing countries. Terra Economicus 21(3), 133–142. DOI: 10.18522/2073-6606-2023-21-3- 133-142

Jena, N. R. ve Sethi, N. (2020). Determinants of foreign exchange reserves in Brazil: An empirical investigation. Journal of Public Affairs, e2216

Kawai, M. (2010). Reform of the international financial architecture: An Asian perspective. *The Singapore Economic Review*, *55*(01), 207-242.

Kaur, R. (2024). The Role of International Reserves to Synthesise Trinity Debate: A Quadrilemma Analysis. *The Indian Economic Journal*, 00194662241278085.
Law, C.-H. (2017). *International reserves and trilemma policy convergence in Malaysia. Applied Economics Letters, 25(8), 535–538.*

Lloyd-Ellis, H., & Nechi, S. (2008). *Foreign Reserves Accumulation in Emerging Economies: Determinants and Sustainability Case of Mexico*. Working Papers of Department of Economics, Queen's University.

Md. Niaz Murshed Chowdhury, Mohammed Jashim Uddin, Dr. Mohammad Saiful Islam. An

Econometric Analysis of the Determinants of Foreign Exchange Reserves in Bangladesh. Journal of

World Economic Research. Vol. 3, No. 6, 2014, pp. 72-82. doi: 10.11648/j.jwer.20140306.12

Misztal, P. (2021). The size and the main determinants of China's official currency reserves in the period 1990-2019. European Research Studies Journal, 24(1), 568-582.

Mishkin, F.S. (1999). Lessons from the Asian crisis. Journal of International Money and Finance, 18(4), 709-723.
Nor, E., Azali, M., Law, S. (2008). International reserves, current account imbalance and external

debt: Evidence from Malaysia. IIUM Journal of Economics and Management 16(1), 47–75.

Perron, P. (1989). The great crash, the oil price shock and the unit root hypothesis. Econometrica, 57, 1361–1401.

Pesaran, M.H., Shin Y. and Smith, R.J. (2001). Bounds Testing Approaches to the Analysis of Level Relationships, Journal of Applied Econometrics, 16, 289-326.

Pesaran, M.H. and Pesaran, C. (1997), Working with Microfit 4.0: Interactive Econometric Analysis, Oxford University Press, Oxford.

Pesaran, M.H. and Smith, R. (1995), "Estimating long-run relationships from dynamic heterogeneous panels", Journal of Econometrics, Vol. 68 No. 1, pp. 79-113.

Pesaran, M.H., Shin, Y. and Smith, R.P. (1999), "Pooled mean group estimation of dynamic heterogeneous panels", Journal of the American Statistical Association, Vol. 94 No. 446, pp. 621-634.

Pesaran, M., Shin, Y. and Smith, R. (2001), "Bounds testing approaches to the analysis of long-run relationships", Journal of Applied Econometrics, Vol. 16, pp. 289-326.

Pina, G. (2017). International reserves and global interest rates. Journal of International Money and

Finance 74, 371–385.

Popovska-Kamnar, N., Nikolov, M., & Sulejmani, A. (2016). Determinants of the international reserves in the Republic of Macedonia. *CEA Journal of Economics*, *11*(2).

Prabheesh, K. P., Malathy, D., & Madhumathi, R. (2007). Demand for foreign exchange reserves in

India: A co-integration approach.

Qian, X., & Steiner, A. (2012). International reserves and the composition of equity capital inflows. *Available at SSRN 2066259*

Sanusi, K.A., Meyer, D.F., & Hassan, A.S. (2019). An investigation of the determinants of foreign

exchange reserves in Southern African countries. Journal of International Studies, 12(2), 201-212.

doi:10.14254/2071-8330.2019/12-2/12

Shevchuk, V. (2015). Determinants of the demand for international reserves in Ukraine. *Metody Ilościowe w Badaniach Ekonomicznych*, *16*(2), 102-112.

Steiner, A. (2009). The accumulation of international reserves by central banks: Exploring causes and consequences. *None*.

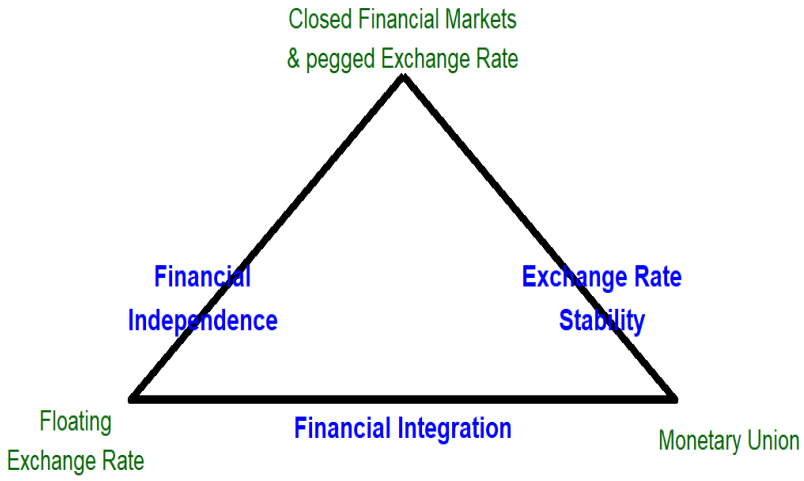
.

Thabana, G., & Fasanya, I. (2024). Determinants of foreign exchange reserves in sub-saharan Africa. *Scientific African*, *26*, e02356.

Wooldridge, J. M. (1996). Introductory Econometrics: A Modern Approach 3rd ed.

Appendix

Figure 6:Traditional Impossible trinity framework



The Traditional Trilemma Framework

Guidotti -Greenspan Rule

Import cover: This measures the number of months that reserves can sustain imports. This indicator is considered relevant for countries with a closed capital account. The benchmark is three months of coverage.

Short-term debt: Reserves should equal short-term external debt (one-year or less maturity), implying a reserves to short term debt ratio of 1.

Broad Money: The benchmark is typically set at 20%.If it is more than 0.2 ,it satisfies the rule.

Figure 7:Trilemma Indices across EMEs

