Determinants of gross international reserves in the case of the Maldives

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Abstract

Purpose – This study aims to examine the determinants influencing gross international reserves of the Maldives.

Design/methodology/approach – This paper uses annual data from 1990 to 2023 and adopts a nonlinear ARDL model for identifying the key determinants of gross international reserves in case of Maldives.

Findings – The authors ascertain that a one standard deviation rise in positive and negative export volatility, short-term debt, per capita income, money supply and interest rates results in an increase in foreign reserves. The most substantial effect arises from shocks to the negative component of export volatility, increasing reserves by 13.85% of the average, followed by per capita income shocks (10.9%) and positive export volatility shocks (10.12%). Interest rates exert a minimal impact, augmenting reserves by merely 0.78%. Conversely, import and exchange rate volatility positively impact reserves, with positive exchange rate volatility reducing reserves by 17.80%, and import volatility decreasing them by 15.72% (positive) and 11.09% (negative).

Practical implications – A key policy message emanating from the aforementioned results is the necessity to mitigate export volatility, particularly the negative component. If successful, this can facilitate the acquisition of reserve reserves. The finding regarding the function of debt suggests that a strategic approach and establishment of multilateral borrowing arrangements will facilitate the preservation of robust reserves. Economic growth and money supply are essential for reserve expansion. Policies that incentivize and promote growth, particularly private sector investments that enhance growth and increase money supply, can fortify reserves; nevertheless, these policies must be carefully designed because failure to optimally design such policies can be costly. In other words, an increase in growth and money supply when boosted can trigger inflationary pressures. The results warn that policies to stabilize the exchange rate and import volatility should not be taken lightly as they are important factors in protecting reserves from external shocks. The data, due to its limited sample size—which should be considered a caveat, indicates a relatively trivial role for interest rates; yet, it is advisable not to disregard this factor. Reserve stability can be supported by not ignoring interest rate.

Originality/value – This study investigate the factors affecting international reserves in the Maldives, a small island economy heavily dependent on tourism, hence enhancing comprehension of policy focus for accumulating foreign reserves. Islamic and Middle Eastern economies should manage export

JEL classification – C21, F30, F31

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volatility, and stabilize reserves via sukuk, and balance growth policies to control inflation and liquidity.

Keywords Foreign exchange reserves, Exchange rate volatility, Export volatility, Import volatility, Short term debt, Nonlinear ARDL model, Maldives, Nonlinearity

Paper type Research paper

1. Introduction

Foreign exchange reserves, usually referred to as foreign reserves, play a vital role in ensuring liquidity and providing macroeconomic stability. Foreign reserves, when healthy provide macroeconomic security when countries are exposed to either internal or external shocks (see IMF, 2012). Healthy foreign exchange reserves are needed for liquidity and security purposes. Foreign reserves protect a country against natural calamities and external shocks including business cycle variations in trading partner countries and commodity price variations (Aizenman and Lee, 2007; Mendoza, 2010; Khan and Anwar, 2022). Mercantilists view foreign currency reserves as a byproduct of export and exchange rate policies (Dooley *et al.*, 2003; Prabheesh, 2013). The gross foreign reserves stabilize exchange rates, fund external payments and reassure investors and creditors. The demand for gross international reserves of an economy heavily relied on so-called "buffer stock" model; see, for example, Kenen and Yudin (1965), Heller (1966), Kelly (1970) and Frenkel and Jovanovic (1981). These studies show that central banks use opportunity costs to choose an optimum level of holding reserves.

The tourism sector significantly contributes to Maldives foreign exchange through export earnings and foreign direct investments; yet, the nation has struggle to amass adequate reserves to shield itself from potential economic shocks. Since 2017, government of Maldives has substantially relied on external borrowings to sustain the nation's reserve position and to fulfil its fiscal commitments and responsibilities. During the COVID-19 pandemic, the Maldivian government depended on substantial financial aid to sustain adequate reserve levels. According to the Ministry of Finance, the government secured external financing amounting to US$562.2m in 2020, along with supplementary in-kind assistance from multilateral and bilateral entities (MMA, 2023). [1]

Additionally, the import-dependent nature of the Maldivian economy demonstrates that global economic shocks, particularly fluctuations oil price shocks, significantly impact the country's reserve levels. In 2022, the current account deficit expanded to 16.3% of GDP primarily due to the increased import expenditures resulting from heightened global commodity prices (attributable to the Russia–Ukraine conflict and subsequent oil price shocks) and higher domestic demand, thereby exerting pressure on the nation's gross international reserves (MMA, 2023). In 2023, this trend persisted, resulting in a current account deficit that expanded to 20.3% of GDP, while the reserve position declined by 29% throughout the year. Deteriorating foreign exchange reserves and growing debt have been major challenges for the Maldives in recent years. In addition to the growing financial issue, the Maldives' economic sovereignty has been downgraded by credit rating agencies because of the country's declining foreign exchange reserves, mostly as a result of high import volumes and a high debt servicing ratio. The significant volatility of global capital flows and commerce also makes it difficult for the nation to correct for its external payments imbalances. "The Maldives Monetary Authority's usable foreign exchange reserves stood at below USD 65 million as of December 2024, an improvement from the alarming low of USD 21.97 million in July 2024," according to the IMF (2025) report. The vulnerability of the Maldives reserve position is underscored by its global ranking. The Maldives is positioned at 154th in worldwide foreign exchange reserves, with US $588m, inclusive of gold (IMF statistics). Considering the susceptibility of the tourism sector to both global and local economic shocks, alongside the Maldivian economy's sensitivity to

fluctuations in global commodity prices, it is crucial to identify the factors influencing gross international reserves. Understanding the importance of those factors is vital for developing policies aimed at ensuring the Maldivian economy maintains sufficient reserve levels for economic stability. The goal of our paper is to primarily identify the key factors influencing the gross international reserves of Maldives.

Our paper contribution to literature can be seen in the following ways. First, despite the fact that there are many studies on the factors influencing global reserves, none of them, as far as we are aware, have looked at this matter in relation to the Maldives. To better understand the policy focus for building up foreign reserves, we look into the elements influencing international reserves in the Maldives, a small island economy that is largely based on tourism. Due to the paucity of study on tiny island economies facing financial challenges, our study fills a vacuum in the literature by providing additional insights which is likely to develop empirical and policy concerns on responsible factors for reserves.

Second, maintaining strong foreign reserves is essential given the growing fiscal difficulties brought on by the COVID-19 pandemic (see Narayan, 2021; Phan and Narayan, 2020). Given the nation's heavy reliance on foreign loans to preserve its reserve position and stabilize its *de facto* fixed exchange rate, the study offers insights into how foreign exchange borrowing and exchange rate policies are made.

Third, the Maldives is vulnerable to global economic shocks and climate change, so it is important to comprehend how natural disasters and outside events, such as disruptions in trade and tourism, affect the country's reserve position. Empirical evidence on this front will ensure that policy makers plan to mitigate the effects of shocks prudently.

Fourth, moving beyond the conventional linear links examined in previous studies, we additionally look at the ongoing discussion around trade and exchange rate volatility. Of importance here is the possible nonlinear relationship between foreign exchange reserves, export volatility and exchange rate swings. To provide a more nuanced view of the underlying dynamics, our study integrates the asymmetric consequences of positive and negative shocks using the Nonlinear Autoregressive Distributed Lag (NARDL) model developed by Shin *et al.* (2014). By doing so, our paper provides a guide on empirical approaches when handling the type of research questions we pose.

The principal findings of the study are as follows: First, a nonlinear long-term relationship exists among the variables. Second, the volatility in export changes has negatively impacted gross international reserves in both the long and short term. Third, fluctuations in exchange rates have similarly detrimentally affected foreign exchange reserves. Fourth, both positive and negative import volatility also adversely influences international foreign exchange reserves. In addition to export and exchange rate volatility, real per capita income and short-term debt positively affect the foreign exchange reserves in the Maldives.

Our results are economically viable and provide assistance to policymakers for monitoring the critical parameters in forecasting foreign reserve building. We demonstrate that a rise of one standard deviation in positive and negative export volatility, short-term debt, per capita income, money supply and interest rates all enhance foreign reserves. The primary factor is shocks to the negative component of export volatility, which elevate reserves by 13.85% of the mean, followed by shocks to per capita income (10.9%) and shocks to the positive component of export volatility (10.12%). A shock to interest rates has the minimal impact on reserves, resulting in a 0.78% increase in the mean reserve. The variables adversely affecting reserves include shocks to imports and currency rate volatility. When the positive component of the exchange rate rises by one standard deviation, reserves decrease by 17.80% of the sample mean, whereas a similar shock to the positive and negative components of import volatility reduces reserves by 15.72% and 11.09%, respectively.

2. Features of the literature and our contribution

2.1 Overview

There is a vast literature on international reserves. Broadly, this research can be categorized into two main streams: the determinants of reserve demand and the optimal level of reserves. Additionally, we identify literature specific to natural disasters and external shocks and the issue of nonlinearity in how they shape foreign reserve accumulation. Two features standout: first, empirical studies dominate this literature and, second, single- and multi-country studies are common.

2.2 Determinants of reserve demand

Voluminous research examines the factors influencing the need for international reserves. The start of this research has roots in the work of Kenen and Yudin (1965), Kelly (1970) and Frenkel (1974), which set the conceptual foundation for empirical work. Following this, empirical evidence was produced suggesting that prices and external shocks were influential in determining foreign reserves; see Aizenman (1998), Edison (2003), Sula (2011) and Choi and Taylor (2022).

External shocks and economic crises have also prominently featured as a factor shaping reserves. Sula and Oguzoglu (2021) identify an exhaustive list of such factors including financial and trade openness in a sample of 108 developing countries, while the relevance of oil prices has been documented in Fatum *et al.* (2021) An important story in their research is that countries with oil reserves experiencing weaker productivity typically maintain more reserves, whereas those with diminished oil reserves but enhanced productivity own less reserves. This discovery underscores the necessity of considering natural resource endowments when assessing reserve levels.

2.3 Optimal reserves

The second principal theme in literature examines the optimal level of reserves. Initial theoretical frameworks, including those by Frenkel and Jovanovic (1981) and Ben-Bassat and Gottlieb (1992), aimed to ascertain the ideal reserves that reconcile the advantages of liquidity with the expenses of maintaining them. Searching for optimality is central to ensuring that excessive reserves are not costly at the same time ensuring that balance-of-payments crises or exchange rate fluctuations can be avoided by not enduring inadequate reserves.

Naturally, the search for optimal reserves has secured an attractive policy research agenda, led by the work of Heller (1966) and Hamada and Ueda (1977), who focused on the cost-benefit trade-offs of reserves. The later studies, primarily by Tule *et al.* (2015) and Abdul-Rahaman *et al.* (2022), improved these models both by using better quality data and advanced econometric approaches. The key message emanating from these studies is that optimal reserves is a function of several factors principally volume of international trade, budget deficits (hence debt levels) and immunity to external shocks. Fitting, in search for India's reserve optimality, Prabheesh (2013) demonstrated the impact of the financial crisis.

2.4 Natural disasters and external shocks

The influence of natural disasters and external economic shocks on reserve levels has received heightened scrutiny. Dominguez *et al.* (2012) discovered that nations with elevated pre-crisis reserves demonstrated more robust post-crisis GDP growth, underscoring the protective function of reserves against global disturbances such as the financial crisis. Specifically, natural disasters induce significant variations in reserve levels due to their effects on trade and capital flows. Khan and Anwar (2022) revealed that natural disasters generally diminish reserves across nations, especially in lower-income economies that frequently lack the financial resilience characteristic of higher-income countries.

The importance of reserves to financially weak countries is demonstrated by Aizenman *et al.* (2024), especially during trade shocks.

2.5 Nonlinear relationships and reserve accumulation

The focus of empirical research has shifted from linear to nonlinear econometric models. The source of nonlinearity can be triggered by structural breaks in the reserves or in any one of its determinants. [2] Greater evidence of statistical significance, for instance, was found by Sula and Oguzoglu (2021) when they used a quantile regression model of reserves determinants. Importance of elasticities at quantiles suggests that reserve buildup varies in response to different economic conditions.

2.6 Gaps and contributions

The richness of the literature on foreign reserves is roots in the understanding of the key factors influencing foreign reserves. Prominent in this menu of factors is economic growth, exchange rate and external trade and price shocks. The literature has highlighted the nonlinearity that exists in models of the determinants of reserves. Internal and external shocks are primarily responsible for this inherent nonlinearity. Our motivation for investigating the determinants of reserves for Maldives within a nonlinear framework has roots in (a) the fact that Maldives fiscal space is constrained and macroeconomic stability as reflected by healthy foreign reserves is paramount. Searching for optimality in reserve levels is an important subject that is shaping policy discourse. Our study contributes to this policy discourse by providing a checklist of important factors that should be at the purview of policy makers. (b) The Maldivian economy has been impact by both domestic and international shocks including trade and business cycle shocks emanating overseas and climate change and political stability shocks that have arisen domestically. These are potential sources of nonlinearity and failure to model nonlinearity will render empirical models spurious. We avert these fears by adopting a nonlinear ARDL model.

3. Data and methodology

This study uses annual data spanning from 1990 to 2023. Data on variables including gross reserves, exchange rate, exports, per capita income and short-term external debt have been compiled, with a comprehensive description of measurement and data sources provided in Table 1.

To examine the determinants of international reserves, we use the Shin *et al.* (2014) nonlinear ARDL (NARDL) model. This model depicts long-run and short-run nonlinearities by incorporating positive and negative partial sum decomposition of explanatory variables. In particular, the NARDL model decomposes exogenous variables into positive and negative components and unlike linear models (such as conventional ARDL, VAR, etc.) do not presuppose symmetric relationships amongst variables. Put differently, identification of potential asymmetric relationships is the main tenant of NARDL. In Shin *et al.*, further details on the methodology can be found. A range of NARDL specifications in the form of an unrestricted error correction model are consistent with the following estimable form:

Model 1 (Based on export volatility):

$$lnRES_t = \propto + \rho RES_{t-1} + \beta_1^+ Volex_{t-1}^+ + \beta_1^- Volex_{t-1}^- + \beta_2^+ Voler_{t-1}^+ + \beta_2^- Voler_{t-1}^-$$

$$+ \gamma_1 lnPCI_{t-1} + \gamma_2 lnSTD_{t-1} + \sum_{i=1}^{p} \delta_i \Delta RES_{t-1} + \sum_{i=1}^{q} \delta_i^+ \Delta Volex_{t-1}^+$$

Table 1. Data and measurement of variables

Acronym	Description	Source
RES	Ratio of gross official reserves to GDP	Maldives monetary authority (MMA)
Volex	Volatility of exports	MMA (estimated)
Voler	Volatility of exchange rate	MMA (estimated)
Volimp	Volatility of imports	MMA (estimated)
PCI	Real per capita GDP	MMA
STD	Short-term debt to GDP	MMA
OILP	Crude oil price in US$	MMA
MS	Money supply to GDP	MMA
IR	Market yield on US treasury securities	MMA
COVID-Dummy	COVID-19 dummy. It is taken 2020 as '1' and other periods '0'	MMA

Note(s): This table describes all variables used in this paper and data collection of these variables from different sources
Source(s): Table by authors'

$$+\sum_{i=1}^{q}\delta_i^{-}\Delta Volex_{t-1}^{-}+\sum_{i=1}^{q}\delta_i^{+}\Delta Voler_{t-1}^{+}+\sum_{i=1}^{q}\delta_i^{-}\Delta Voler_{t-1}^{-}+U_t \tag{1}$$

Model 2 (Based on import volatility):

$$\begin{aligned}lnRES_t = {} & \propto+\rho RES_{t-1}+\beta_1^{+}Volimp_{t-1}^{+}+\beta_1^{-}Volimp_{t-1}^{-}+\beta_2^{+}Voler_{t-1}^{+}+\beta_2^{-}Voler_{t-1}^{-}\\ & +\gamma_1 lnPCI_{t-1}+\gamma_2 lnSTD_{t-1}+\gamma_3 lnOILP_{t-1}+\gamma_4 lnMS_{t-1}+\gamma_5 lnIR_{t-1}\\ & +\gamma_6 COVIDDummy+\sum_{i=1}^{p}\delta_i\Delta RES_{t-1}+\sum_{i=1}^{q}\delta_i^{+}\Delta Volimp_{t-1}^{+}\\ & +\sum_{i=1}^{q}\delta_i^{-}\Delta Volimp_{t-1}^{-}+\sum_{i=1}^{q}\delta_i^{+}\Delta Voler_{t-1}^{+}+\sum_{i=1}^{q}\delta_i^{-}\Delta Voler_{t-1}^{-}+U_t\end{aligned} \tag{2}$$

where, *RES* denotes gross international reserves, *Volex* denotes the volatility of exports, *Volimp* represents the volatility of imports, *Voler* pertains to the volatility of the bilateral exchange rate between MVR to USD, *PCI* indicates per capita income, *STD* refers the short-term debt, *OILP* denotes oil price, *MS* signifies to money supply and *IR* represents the interest rate. All unknown parameters emphasized in equations (1)–(2) pertain to both dependent and independent variables, Δ denotes the first difference term, and all parameters linked to Δ and lag operators are classified as short-term coefficients. U_t represents the error term which is independently and identically distributed (iid) with a mean of zero and constant variance.

The positive and negative components of export volatility, represented as *Volex* can be expressed by the partial sum approach as follows:

$$Volex_t^{+}=\sum_{j=1}^{t}\Delta Volex_j^{+}=\sum_{j=1}^{t}max(\Delta Volex_j,0) \tag{3}$$

$$Volex_t^- = \sum_{j=1}^{t} \Delta Volex_j^- = \sum_{j=1}^{t} \min(\Delta Volex_j, 0) \quad (4)$$

Equations (5) and (6) below illustrate the import volatility of both positive and negative components:

$$Volimp_t^+ = \sum_{j=1}^{t} \Delta Volimp_j^+ = \sum_{j=1}^{t} max(\Delta Volimp_j, 0) \quad (5)$$

$$Volimp_t^- = \sum_{j=1}^{t} \Delta Volimp_j^- = \sum_{j=1}^{t} \min(\Delta Volimp_j, 0) \quad (6)$$

Finally, the positive and negative components of exchange rate volatility is extracted as follows:

$$Voler_t^+ = \sum_{j=1}^{t} \Delta Voler_j^+ = \sum_{j=1}^{t} max(\Delta Voler_j, 0) \quad (7)$$

$$Voler_t^- = \sum_{j=1}^{t} \Delta Voler_j^- = \sum_{j=1}^{t} \min(\Delta Voler_j, 0) \quad (8)$$

Certain exogenous variables are decomposed into x_t^+ and x_t^- relative to a threshold value of zero to differentiate between positive and negative fluctuations in the volatility of exports, imports and exchange rates. The Wald-*F* test is used to ascertain the symmetric or asymmetric effects of export volatility and exchange rate volatility on foreign currency reserves. The null hypothesis (H_0) posits the existence of a symmetric relationship.

4. Empirical results

4.1 Descriptive statistics

This section discusses the empirical results of the study. Before discussing the key results, we first present the descriptive statistics, which are illustrated in Table 2.

The mean value of *lnRES* is 2.60 with a standard deviation is approximately 0.28. The average positive change in export volatility is the biggest amongst the variables presented in Table 2. The standard deviation of $Volex_t^+$ is 24.02, indicating greater volatility relative to other variables. The Jarque-Bera statistics reveal that all series are normally distributed except $Volex_t^-$. The results of unit root testing are presented in Table 3.

What are the implications of these descriptive statistics for our nonlinear modelling strategy? First, we observe substantial evidence of positive skewness ($Volex_t^-$) and negative skewness ($Volimp_t^-$ and *lnPCI*), indicating deviations from linearity. The kurtosis test indicates the presence of heavy tails for $Volex_t^-$ and flatter tails for $Volimp_t^-$ and $Voler_t^-$. The evidence of non-normality for $Volex_t^-$ in conjunction with these statistics indicates that applying a linear model will be deceptive and yield erroneous findings. These statistics substantiate our utilization of a NARDL model.

4.2 Cointegration test results

The results from Table 4 clearly indicate an existence of long-run nonlinear cointegrating relationship among these variables. It further reveals that positive and negative changes in

Table 2. Descriptive statistics

Key statistics	*lnRES*	$Volex^+$	$Volex^-$	$Voler^+$	$Voler^-$	$Volimp^+$	$Volimp^-$	*lnPCI*	*lnSTD*	*lnIR*	*lnMS*	*lnOILP*
Mean	2.61	26.34	−10.05	15.86	−33.65	1.13	−1.13	11.73	1.84	0.07	3.71	3.72
Median	2.60	39.67	−3.48	13.60	−34.32	1.02	−0.59	11.80	1.77	0.85	3.73	3.84
Maximum	3.28	74.62	0.00	32.49	−2.27	2.93	0.00	12.13	2.89	1.88	4.28	4.65
Minimum	2.09	0.30	−38.9	0.00	−67.64	0.01	−3.05	11.19	0.58	−3.91	3.22	2.57
SD	0.28	24.02	15.0	10.9	17.54	0.94	0.95	0.26	0.51	1.79	0.25	0.67
Skewness	0.31	0.44	−1.35	0.42	−0.21	0.44	−0.41	−0.56	0.23	−0.75	0.02	−0.12
Kurtosis	2.56	2.08	2.92	2.01	2.23	1.91	1.73	2.35	3.18	2.04	2.41	1.56
Jarque-Bera	0.80	2.25	10.01	2.32	1.04	2.74	3.18	2.32	0.34	4.48	0.01	3.02
Probability	0.67	0.32	0.01	0.31	0.59	0.25	0.20	0.31	0.84	0.11	0.99	0.22
Sum	85.9	869.4	−331.7	523.5	−1110.4	37.2	−37.6	387.1	60.7	2.30	126.02	126.55
Sum Sq. Dev.	2.61	18471.6	7200.1	3802.5	9846.4	28.8	29.43	2.19	8.41	106.47	2.03	15.02
Observations	33	33	33	33	33	33	33	33	33	33	33	33

Note(s): This table presents the descriptive statistics of all variables used in this paper. *lnRES* = log of gross international reserves, $Volex^+$ refers to cumulative positive of volatility of export, $Volex^-$ refers to cumulative negative of volatility of export, $Voler^+$ refers to cumulative positive of volatility of exchange rate, $Voler^-$ refers to cumulative negative of volatility of exchange rate, $Volimp^+$ refers to cumulative positive of volatility of import, $Volimp^-$ refers to cumulative negative of volatility of import, *lnPCI* refers per capita GDP, and *lnSTD* is short-term debt, *lnIR* refers to interest rate, *lnMS* is the money supply, and *lnOILP* refers to crude oil price
Source(s): Table by authors’

Table 3. Results of unit root tests

Variables	ADF unit root with break test		Philips-Perron test	
	Intercept	Trend and intercept	Intercept	Trend and intercept
lnRES				
Level	−3.63	−3.99	−2.89**	−2.74
First difference	−6.96***	−6.77***	–6.82***	−7.14***
Volex_POS				
Level	−1.68	−3.02	0.25	−1.96
First difference	−5.23***	−5.79***	−3.85***	−3.82**
Volex_NEG				
Level	−4.44**	−43.5***	−0.03	−1.52
First difference	–	–	−5.45***	−5.61***
Voler_POS				
Level	−3.59	−11.77***	−0.35	−2.63
First difference	−12.72***	–	−6.32***	−6.21***
Voler_NEG				
Level	−2.19	−4.54	0.50	−2.40
First difference	−7.61***	−6.23***	−5.91***	−5.79***
lnPCI				
Level	−3.02	−4.55	−1.23	−3.31***
First difference	−8.06***	−7.43***	−13.62***	–
lnSTD				
Level	−3.85	−4.32	−2.32	−2.35
First difference	−6.67***	−6.94***	−7.33***	−8.47***
Volimp_POS				
Level	−1.12	−3.79	1.23	−2.44
First difference	−7.71***	−7.71***	−6.27***	−7.06***
Volimp_NEG				
Level	−2.30	−3.78	1.21	−1.63
First difference	−6.65***	−6.64***	−5.22***	−5.58***
InOILP				
Level	−3.51	−4.66*	−0.99	−2.01
First difference	−6.32***	−6.43***	−5.27***	−5.15***

Note(s): This table presents the results of unit root tests. Both ADF unit root with break test and Philips-Perron tests are used to test the stationary property of all the variables used in this paper. Finally, ***, ** and * indicate the level of significance rejecting null hypothesis at the 1, 5 and 10% levels, respectively
Source(s): Table by authors'

Table 4. Bound test for nonlinear cointegration results

Test statistic	Model 1 (1,0,1,1,0,0,0)		Model 2 (1,1,1,0,0)	
F-statistic	4.087**		22.65**	
	I(0)	I(1)	I(0)	I(1)
Bound critical values by Pesaran *et al.* (2001)	2.45	3.61	2.86	4.01

Note(s): This table shows the NARDL bound testing results. The null hypothesis is that there is no nonlinear cointegration and ** denotes rejection of the null hypothesis at the 5% level of significance based on Pesaran's critical value
Source(s): Table by authors'

export, import and exchange rate in previous year may still affect the present value of gross foreign exchange reserves in Maldives.

4.3 Long-run statistical and economic significance

The long-term estimates of the factors influencing gross international reserves in the Maldives, as shown in Table 5, indicate some significant relations. In Model 1, both positive and negative export volatility ($Volex_t^+$ and $Volex_t^-$) have significant positive impacts on reserves, with coefficients of 0.057 (*t*-stat. = 7.125) and 0.125 (*t*-stat. = 7.764), respectively. The economic significance of these slope coefficients suggests that with a one standard deviation increase in $Volex_t^+$ ($Volex_t^-$) of 24.02 (15.00), gross reserves will increase by 10.12% (13.85%) of the sample mean reserves (=13.53). The asymmetric is clear: with every one standard deviation shock the positive effect of export volatility increases the reserves by 10.12%. However, when one standard deviation decline in volatility of exports hits reserves by declining it to 13.85%.

In Model 2, the impacts of import volatility ($Volimp_t^+$ and $Volimp_t^-$) also exert a positive effect on reserves. The slope coefficients are 2.153 (*t*-stat. = 4.546) and 1.514 (*t*-stat. = 3.336) for $Volimp_t^+$ and $Volimp_t^-$ respectively. Economically, a one standard increase in $Volimp_t^+$ (0.949) and $Volimp_t^-$ (0.956) reduce reserves by 15.72% and 11.09% of the sample mean of reserves (=13.53).

Likewise, both positive and negative exchange rate volatility ($Voler_t^+$) and ($Voler_t^-$) substantially increases reserves (0.221, t-stat. = 5.862), 0.061 (t-stat. = 0.327), respectively. This implies that when there is a depreciation of MVR against USD then it increases the reserves by 0.221. However, when there is an appreciation of MVR against USD then it decreases the reserves by 0.061. Economically, the effect of ($Voler_t^+$) suggests that a one standard deviation increase (=10.90) increases reserves by 17.80% of its sample mean.

On the other hand, per capita income (5.642, t-stat. = 5.879), short-term debt (1.079, t-stat. = 5.906), money supply (1.922, t-stat. = 6.847) and interest rate (0.059, t-stat. = 1.879) boost reserves. From an economic significance viewpoint, we find that a one standard deviation increase in PCI (=0.261), STD (=0.3513), MS (= 0.248) and IR (= 1.796) raise reserves by 10.9%, 4.09%, 3.522% and 0.783% of the mean reserves, respectively.

Table 5. Results of NARDL long-run estimates

Variables	Model 1	Model 2
Volex_POS	0.057*** (0.0080)	–
Volex_NEG	0.125*** (0.0161)	–
Volimp_POS	–	2.153*** (0.4736)
Volimp_NEG	–	1.514*** (0.4538)
Voler_POS	0.221*** (0.0377)	0.018 (0.0893)
Voler_NEG	0.061*** (0.0186)	0.050 (0.0309)
lnPCI	5.642*** (0.9597)	1.616*** (0.3758)
lnSTD	1.079*** (0.1827)	−0.011 (0.1052)
lnOILP	–	0.1339 (0.1324)
lnMS	–	1.922*** (0.2807)
lnIR	–	0.059* (0.0314)
COVID-Dummy	–	0.471** (0.1830)

Note(s): This table shows the long-run estimates of the determinants of gross international reserves in Maldives where ***, **, * indicate the level of significance at the 1, 5 and 10% levels, respectively. The numbers within parentheses are standard errors
Source(s): Table by authors'

The Wald test coefficient (4.0874) rejects the null hypothesis of a symmetric relationship, indicating asymmetric long run relationship between gross international reserves, exports, imports and exchange rates in Maldives.

4.3.1 An explanation of the long-run results. In theory, the volatility of exports is expected to have positive correlation with reserves. We also observe a positive and statistically significant relation between export and reserves. An increase in export boosts the demand for reserves and a decline in export reduces the reserves in Maldives. However, the magnitude of increase and decrease of exports on gross reserves are different. This finding aligns with studies indicating that the impact of export volatility on international reserve accumulation is mixed (Sula, 2011; Ghosh *et al.*, 2014). Sula (2011) discovered that export volatility negatively impacts the demand for reserves in the lower quartile among developing countries, whereas Ghosh *et al.* (2014) found that export volatility is not significant for international reserves, especially when regressed across various quantiles for Pacific Rim countries. The outcomes of quantile regressions exhibit nonlinearity, allowing for direct comparison with the results of the NARDL model. Moreover, given that the Maldives is vulnerable to external shocks, any fluctuations in exports can adversely impact the international reserve accumulation. Likewise, the long-run coefficients of both positive and negative fluctuations in exchange rate volatility positively impact gross international reserves. While it is anticipated that the depreciation of the domestic currency will draw greater reserves and that will diminish reserve, exchange rate fluctuation consistently engenders economic uncertainty. This uncertainty stemming from increased exchange rate volatility can adversely impact the international reserve position particularly for a small country such as Maldives. The study identifies that alongside export and exchange rate volatility, real per capita income and short-term debt to GDP influence gross international reserves. The importance of per capita income to currency reserves aligns with prior research (Sula, 2011; Ghosh *et al.*, 2014; Aizenman *et al.*, 2024).

4.4 Short-term results

The short-run coefficients of the factors influencing gross international reserves, as seen in Table 6, offer valuable insights into the dynamics of reserves in the Maldives. The Error Correction Term (ECT) in Model 1 has a coefficient of −0.54 (t-stat. = 2.621), signifying that 54% of the short-term divergence from the long-term equilibrium is rectified during the subsequent year. The negative component of export volatility is observed to enhance gross international reserves. A shock to the positive component of exchange rate volatility adversely and considerably impacts reserves, whereas the negative component of exchange rate volatility exerts a positive influence. This indicates that any fluctuations movement in the MVR vis-a-vis the US dollar dampens reserves. Furthermore, a rise in real per capita income adversely affects reserves. A credible rationale for this may be that an increase in per capita income results in heightened demand for both domestic and international commodities, thereby elevating import volumes and hurting reserve accumulation. An increase in the short-term debt-to-GDP ratio favorably influences reserves, contrasting conventional hypothesis. This may be attributed to the Maldives' considerable dependence on external borrowing to sustain its reserve status and fulfill budgetary responsibilities since 2017, especially via multilateral and bilateral loans. Findings from Model 2 demonstrate that import volatility, exchange rate volatility, per capita income and short-term debt do not significantly influence reserves in the short-run. An increase in money supply, however, positively correlates with increased reserves, indicating that liquidity growth may enhance reserves.

Table 6. NARDL short-run estimates for the determinants of international reserves

Variables	Model 1	Model 2
ECT (−1)	−0.54** (0.206)	−1.305*** (0.313)
ΔlnRES(t - 1)	−0.10 (0.182)	0.494* (0.255)
ΔVolex_POS	0.008 (0.012)	–
ΔVolex_NEG	0.052* (0.027)	–
ΔVolex_NEG(t - 1)	0.013 (0.009)	–
ΔVolimp_POS	–	−0.436 (0.372)
ΔVolimp_NEG	–	0.609 (0.374)
ΔVoler_POS	−0.038** (0.017)	−0.031 (0.101)
ΔVoler_POS(t - 1)	−0.086** (0.038)	–
ΔVoler_NEG	0.045** (0.020)	−0.069 (0.048)
ΔlnPCI	−1.172** (0.496)	0.039 (0.499)
ΔlnSTD	0.767** (0.305)	0.095 (0.117)
ΔlnOILP	–	−0.215 (0.192)
lnMS	–	0.892** (0.426)
lnIR	–	0.022 (0.036)
COVID-Dummy	–	0.484 (0.326)
Constant	21.98** (10.525)	−3.09 (4.904)
□2	0.534	0.48
D-W stat	2.01	1.59
F-Stat	3.16 (0.018)	3.05 (0.017)

Note(s): This table displays the results of error correction mechanism and effect of various determinants on gross international reserves in the short-run where ***, ** and * indicate the level of significance (rejecting null hypothesis) at the 1, 5 and 10% levels, respectively. The numbers within parentheses are standard errors
Source(s): Table by authors'

4.5 Diagnostic test outcomes

To verify the robustness of our empirical NARDL model results, Table 7 reports post-estimation diagnostic results. All necessary diagnostic tests are used with the Jarque–Bera test favoring a normal distribution. We discover no evidence of heteroscedasticity or autocorrelation. The Ramsey RESET test favors the specification of the NARDL model while its stability is approved by both the CUSUM and CUSUM Square plots. Overall, therefore, of the outcomes from the NARDL model is ideal.

Table 7. Post-estimation diagnostic test results

Diagnostic test	Model 1	Model 2
Jarque-Bera test statistics	0.694 ^{ns} (0.7065)	0.2983 ^{ns} (0.8614)
Heteroscedasticity: Breusch–Pagan–Godfrey test	0.6513 ^{ns} (0.7959)	0.5831 ^{ns} (0.854)
Breusch-Godfrey serial correlation – LM test	0.0353 ^{ns} (0.8538)	2.7473 ^{ns} (0.1256)
Ramsey RESET test	0.0503 ^{ns} (0.8260)	0.3598 ^{ns} (0.5608)
CUSUM test	Stable	Stable
CUSUM SQ test	Stable	Stable

Note(s): This table presents all diagnostic test results (test statistics) related to NARDL model. The numbers parentheses are probability values
Source(s): Table by authors'

5. Conclusions

There is a dearth of empirical evidence on small island economies on the determinants of foreign reserves. Investigations are needed given that such economies have experienced structural shocks (both domestic and external, including climate change shocks) that have impacted their fiscal position. Sub-optimal levels of foreign reserves spell fiscal and macroeconomic dangers that can trigger instability and uncertainty hurting economic growth. Maldives—an island economy—finds itself precariously placed from a fiscal capacity viewpoint.

The goal of this paper was to identify a list of factors that should be in the purview of Maldivian policymakers when it comes to monitoring international reserves. Keeping in mind the importance of internal and external shocks, we use a nonlinear econometric framework to identify of importance of factors that influence reserves.

The principal findings of the study are as follows: First, a nonlinear long-term relationship exists among the variables. Second, the volatility in export changes has positively impacted gross international reserves in both the long and short term. Third, fluctuations in exchange rates have affected foreign exchange reserves. Fourth, both positive and negative import volatility also positively and negatively influences international foreign exchange reserves. In addition to export and exchange rate volatility, real per capita income and short-term debt positively affect the foreign exchange reserves in the Maldives.

Our results are economically viable and provide assistance to policymakers for monitoring the critical parameters in forecasting foreign reserve building. We demonstrate that a rise of one standard deviation in positive and negative export volatility, short-term debt, per capita income, money supply and interest rates all enhance foreign reserves. The primary factor is shocks to the negative component of export volatility, which elevate reserves by 13.85% of the mean, followed by shocks to per capita income (10.9%) and shocks to the positive component of export volatility (10.12%). A shock to interest rates has the minimal impact on reserves, resulting in a 0.78% increase in the mean reserve. The variables adversely affecting reserves include shocks to imports and currency rate volatility. When the positive component of the exchange rate rises by one standard deviation, reserves decrease by 17.80% of the sample mean, whereas a similar shock to the positive and negative components of import volatility reduces reserves by 15.72% and 11.09%, respectively.

A key policy message emanating from the aforementioned results is the necessity to mitigate export volatility, particularly the negative component. If successful, this can facilitate the acquisition of reserve reserves. The finding regarding the function of debt suggests that a strategic approach and establishment of multilateral borrowing arrangements will facilitate the preservation of robust reserves. Economic growth and money supply are essential for reserve expansion. Policies that incentivize and promote growth, particularly private sector investments that enhance growth and increase money supply, can fortify reserves; nevertheless, these policies must be carefully designed because failure to optimally design such policies can be costly. In other words, an increase in growth and money supply when boosted can trigger inflationary pressures. Our results warn that policies to stabilize the exchange rate and import volatility should not be taken lightly as they are important factors in protecting reserves from external shocks. Our data, due to its limited sample size—which should be considered a caveat, indicates a relatively trivial role for interest rates; yet, it is advisable not to disregard this factor. Reserve stability can be supported by not ignoring interest rate.

The study's conclusions have significant ramifications for economies in the Middle East and the Islamic world, especially those that have structural traits with the Maldives, such as a heavy reliance on foreign commerce, tourism and commodity exports. Due to their heavy reliance on oil exports, many Middle Eastern economies—including those of the Gulf Cooperation Council (GCC)—are susceptible to fluctuations in the world energy markets. According to our findings, controlling export volatility—particularly reducing negative shocks—can be a crucial tactic for maintaining foreign reserves. Adopting reserve management strategies that protect against

export fluctuations through sovereign wealth funds, sukuk (Islamic bonds) and strategic currency stabilization policies can help improve macroeconomic resilience for Islamic economies, where Sharia-compliant financial systems frequently place an emphasis on stability and risk-sharing. Since risk-sharing mechanisms in Islamic banking could be used to promote liquidity management, the role of short-term debt as a reserve determinant also fits with the finance architecture of many Islamic economies.

The Maldives can also teach Islamic and Middle Eastern economies how important it is to strike a balance between inflation management and growth measures. The report emphasizes that while economic expansion and an expanded money supply boost foreign reserves, if excessive liquidity is not properly controlled, it may lead to inflationary pressures. This is especially important for Islamic financial systems, as Sharia compliance limits the use of traditional monetary policy instruments like interest rate changes. Alternative methods, like central bank sukuk, profit-and-loss sharing plans and liquidity management frameworks, can be extremely important in maintaining reserve stability. Furthermore, since exchange rate volatility can deplete reserves, maintaining exchange rate stability is essential for nations with dollarized financial systems or pegged currencies. Therefore, to protect their foreign reserves from outside shocks, policymakers in Islamic and Middle Eastern economies should place a high priority on economic diversification, well-structured debt finance and sensible trade policies.

Finally, we believe our study opens up additional avenues for future research on Maldives following other Islamic countries. For example, fiscal policy effectiveness can be modelled within a DSGE framework following for instance Juhro *et al.* (2023). Additionally, fiscal policy forecasting models that integrate monetary policy can be developed and tested using frameworks suggested in Juhro and Njindan Iyke (2019) and Sharma (2019). Finally, since volatility spillovers can impact fiscal policy effectiveness, future studies should model volatility spillovers using frameworks such as in Devpura (2021) and Devpura *et al.* (2021).

Notes

1. Fu and Chang (2021), among others, show how governments' financial position was affected by the COVID-19 pandemic.
2. We implemented the Narayan and Popp (2010; 2013) two endogenous structural break tests. To conserve space, we do not present results here, but they are available upon request. The main feature of the results is that reserves can be characterised by two structural breaks.

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