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Article

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FINANCIAL ECONOMICS | RESEARCH ARTICLE

The dynamics of the relationship between foreign exchange reserves and import demand function

Ibtisam Al Abri^{1,2*}, Behnaz Saboori¹ and Razan Al Humaidi³

Abstract: This study empirically investigates the dynamics of the relationship between import demand and foreign exchange reserves for an oil-rich and high-income developing country, Oman. This study employs the Autoregressive Distributed Lag (ARDL) model to investigate the impact of real income, domestic prices, and foreign exchange reserves on aggregate and disaggregated import demand function. Results reveal that total imports are significantly affected by domestic prices only; whereas, demand for goods import is influenced by income. The level of foreign exchange reserves does not influence import demand function. These findings indicate that currency peg stabilization efforts, foreign asset leakages and varying sources of foreign currency could have weakened the link between foreign reserves and import levels. Considering domestic prices and income, competition and efficient production of local goods and services should be further encouraged, especially concerning ongoing issues like food security. Understanding import dynamics enhances robust import forecasts, international trade planning and policy formulation.

Subjects: Macroeconomics; Public Finance; Banking; Strategic Management

Keywords: Import demand function; Foreign exchange reserves; Cointegration; Autoregressive Distributed Lag (ARDL) model; Oman

JEL Classifications: E52; E58; F13; F31

1. Introduction

In an all-integrated and entangled world system of various activities of exchange, economies prove to be interdependent on each other. Economies all across the world exchange a huge deal between each other on a daily basis, such as capital which includes exchanging commodities, services, information, and labor. Variations and trends of such exchanges are proved to have a great significance on economic systems, with some economies being more prone to shocks than others by virtue of their size, geographical location, and available resource. With regard to international trade, trade in goods and services can bring substantial economic and social benefits and consequences (Boudreaux, 2018; Irwin, 2020; Zaibet et al., 2022). Therefore, it has become necessary for countries to investigate the dynamics of trade, particularly import demand mechanism of countries with a high level of imports like Oman. Deriving and understanding macroeconomic variables that most explain fluctuations in the import demand levels of a country are used for meaningful import forecasts, international trade planning, and policy formulation (Ahad & Dar, 2018). This has continuously incentivized researchers to empirically study and model aggregate import demand function for developed and developing countries. Theoretically, previous studies focused on relative prices and domestic income indicators as determining factors of imports demand for both developed (Carone, 1996; Giovannetti, 1989; Marston, 1971; Tang, 2003) and

developing countries (A. C. Arize & Malindretos, 2012; Aziz & Bhaban, 2012; Bahmani-Oskooee & Rhee, 1997; Dutta & Ahmed, 1999; Emran & Shilpi, 1996; Hossain, 1995; Islam & Hassan, 2004; Mah, 1997; Sinha, 2001). In addition, foreign exchange reserves play a vital role in shaping and financing import demand, especially for developing countries with fixed or partially flexible exchange rates to maintain the exchange rate at or near the official target level (A. C. Arize & Osang, 2007). Foreign reserves play the role of an international liquidity constraint that influences countries' capability to import necessary goods and services. Therefore, it is expected that an increase in the level of foreign reserve may be accompanied by an increase in import of goods and services (A. C. Arize & Osang, 2007).

This study provides insight from Oman which is a member in the Gulf Cooperation Council (GCC) that has not been previously studied in this context. In addition, previous studies have not adequately and separately examined GCC countries as oil-rich states with a fixed exchange rate regime which are not usually poolable with other countries when empirically investigating macro-economic variables (Esfahani et al., 2014). These countries exhibit a distinct economic structure that require a special attention in macroeconomic literature (Al Abri & Al Bulushi, 2022; Al-Abri et al., 2019). Oman is a small open economy that is integrated with the rest of the world through trade agreements and regional and international alliances as a net exporter of oil and with a high level of imports (Boughanmi et al., 2021), as shown in Figures 1 and 2. Oman is heavily reliant on the export of oil for financing government expenditure which largely drives economic activity. Furthermore, Oman's total consumption is mainly satisfied by imports (Figure 3). Inflows and outflows of funds in and out of Oman have therefore become crucial indicators of the status of the economy. An important indicator that exhibits the dynamics of such movements is the level of foreign currency reserves in the economy.

Similar to other oil exporting economies, especially those of the Gulf Cooperation Council, Oman has maintained a fixed exchange rate (peg) to the US dollar since 1973 as it receives payments of oil export revenues in US dollar. A fixed exchange rate regime is beneficial for developing economies like Oman in numerous ways including that it provides a stable inflation anchor (Calvo & Végh, 1999) and that it helps build a de-facto sovereign wealth fund when financial markets are underdeveloped (Wills & Van der Ploeg, 2014). With such exchange rate regime and with an open capital account, Oman thus adopts the monetary policy of the United States to maintain this peg. Oman is also required to keep a sufficient amount of US dollars in reserves in order to defend this peg and maintain the fixed exchange rate of 1 Rial Omani = USD 2.6008 since 1986. Being the

Figure 1. Oman total imports, total exports, and total hydrocarbon exports 2011–2020.

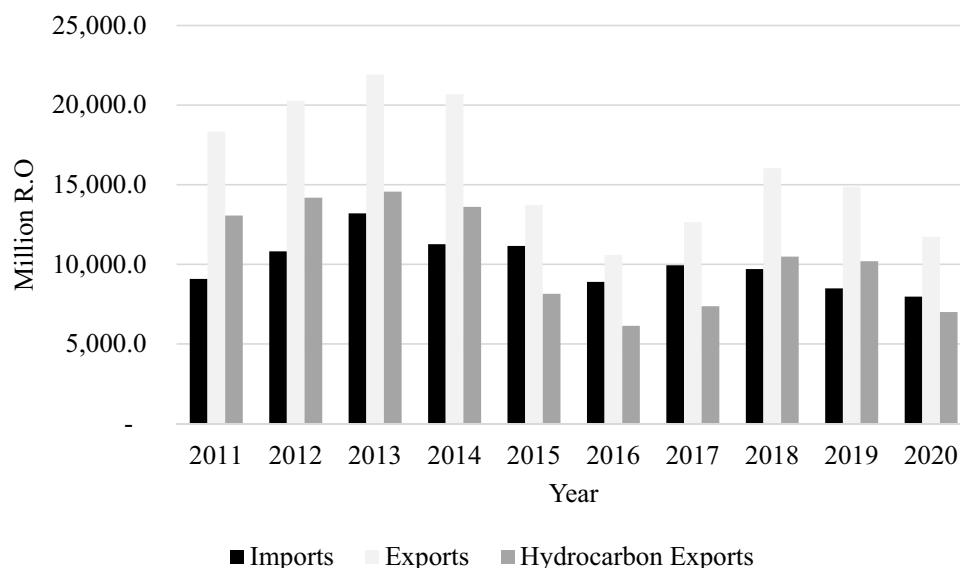


Figure 2. Oman exports and imports share of GDP 2011–2020.

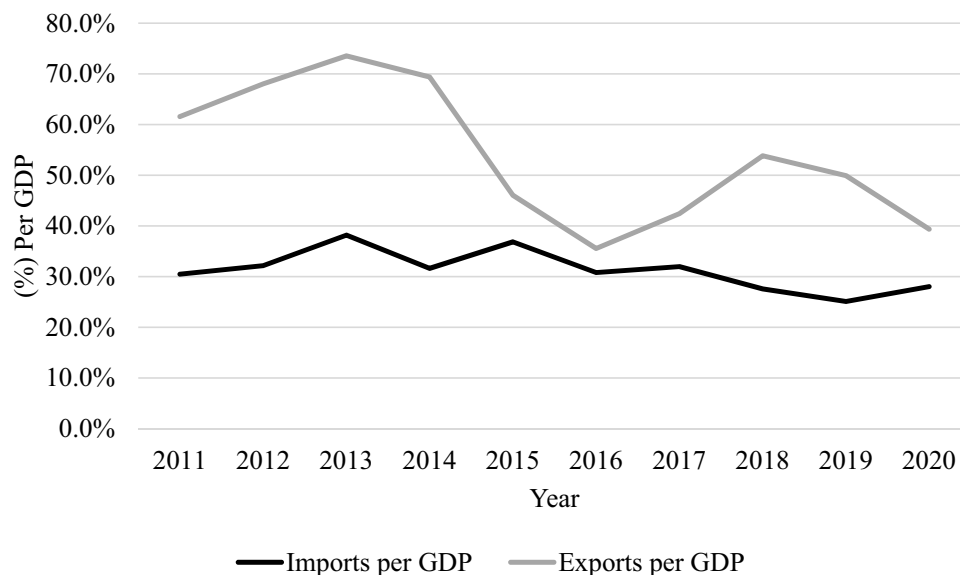
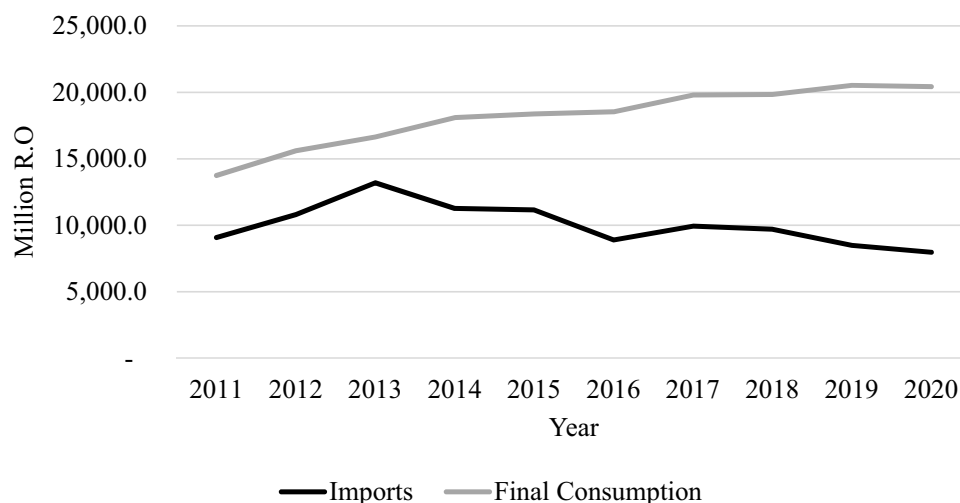


Figure 3. Oman total imports and final consumption 2011–2020.



banker of the government, the Central Bank of Oman (CBO) maintains such foreign exchange reserves to serve this purpose. The accumulation and management of foreign currency reserves at the Central Bank are practices carried out strategically to serve the needs of the government and the private sector – one of which is financing the import purchases. In fact, the “import cover” indicator, which is the number of months-worth of imports that can be financed using the central bank’s foreign exchange reserves, is one of the main benchmarks that central banks use to maintain a minimum level of foreign exchange reserves.

The objective of this research paper is to constitute an import demand function for the Omani economy, through which we aim to understand the behavior of major determinants of Omani imports in the long and short term. Thus, we model an aggregate and disaggregate import demand function as a function of domestic income, the domestic prices, and the level of foreign exchange reserves. We stress the most on the level of foreign exchange reserves as a variable that exhibits the capacity of a country to finance its imports and as a critical measure that must be maintained at a sufficient level to uphold a fixed exchange rate of the Omani Rial to the US Dollar. We have employed recent advances in econometric time-series modelling, particularly

Autoregressive Distributed Lag (ARDL) model using time series data during 1980–2019 to investigate three empirical aspects: examining long-run relationships among studied variables; determining the sign, magnitude and statistical significance of the long-run effects; and investigating the short-run dynamics of the import demand function. To the extent of our knowledge, this is the first attempt that examines aggregate and disaggregate import demand function both in the long- and short-run relations for an oil-rich and high-income developing country. Moreover, the significance of this research lies in the constitution of the Omani economy as a small open economy whose economic activities are majorly financed through the export of hydrocarbon resources, as well as its high dependence on imports for consumption. The policy implications of sufficiently answering the questions of this study could allow the CBO and other government entities to make better informed decisions in terms of management of overall reserves given different expected trends and shocks in the domestic demand for imports as well as developing the relevant policies of mitigating high imports and encouraging consumption of domestic goods.

2. Literature review

Approaches to estimating a country's aggregate import demand function have evolved and become specialized for different types of economies with specific solutions to data availability issue. In a general sense, a traditional import demand function is measured through the income and price elasticities. A. Arize and Afifi (1987) found that aggregate import demand responds to relative prices of imports and with higher responsiveness to changes in domestic goods' prices than to import prices. Early work such as Faini et al. (1988) on import demand of developing economies found that an economy's size, income per-capita, and trade openness are significant determinants of import elasticities. The study found that as countries move from low levels of per capita income to higher levels, their income elasticities increase initially but then decrease as they reach higher incomes. On the other hand, for a given income and size, price elasticity increases considerably with a higher trade share. Furthermore, Kolluri and Torrisi's (1987) estimated major oil-exporting developing countries' aggregate import demand elasticities and showed that real GDP is positively associated with import demand with an average elasticity of 1.5, while relative prices elasticity was less consistent among the countries in question. It is noteworthy that Saudi Arabia had a statistically strong evidence that import demand is highly influenced by relative prices.

Later literature, the most significant of which is Moran's (1989) addressed other potential determinants of import demand such as the availability of foreign exchange reserves. Moran's (1989) introduced factors that exemplify a country's capacity to import, namely foreign exchange inflows and international reserves. Using data for twenty-one developing countries, Moran's model treated import prices as endogenous thus showing that, in cases of low foreign currency inflows and low international reserves, governments attempt to reduce aggregate import demand by increasing domestic import prices through trade barriers. Moran's research was motivated by the foreign lending crunch in the 1980s with interest rates and foreign debt servicing costs increasing leading to the shortages in foreign exchange reserves.

The relationship between foreign exchange reserves and import demand has been examined in the cases of different economies and types of exchange rate regimes. Both directions of the relationship were presented and examined. Heller (1966) derived the level of optimal international reserves using a cost-benefit function in which the marginal propensity to import was a major component and implied a negative relationship between the two as a result of the model test. Heller's explanation was that a country's high propensity to import would lower the marginal cost of adjustment and hence a lower demand for international reserves. On the other hand, Frenkel (1974) examined the demand for international reserves by developed and less-developed countries and proved that for both groups, the level of reserve holdings and the relative size of the foreign trade sector are positively correlated as trade openness indicated vulnerability to external shocks. Frenkel's demand function included three main variables: "(i) a measure of the variability of international receipts and payments; (ii) a scaling variable measuring the size of international

transactions, represented by the level of imports; (iii) the average propensity to import, of the relative size of the foreign trade sector” (Frenkel, 1974).

Other studies found the opposite relationship to be true such as A. C. Arize et al. (2004) on the case of Pakistan; that an accumulation of foreign exchange reserves exerts a significant positive effect on import demand in the long run but not on the short run. They tested the same theory on a number of different sets of countries such as African countries (A. C. Arize & Nippani, 2010), Latin American countries (A. C. Arize & Osang, 2007) and Asian countries (A. C. Arize & Malindretos, 2012) and found the relationship to be significant in both the long run and short run. On the other hand, Sultan (2011) who estimated India’s real imports in terms of real income, relative price of imports, and real foreign exchange reserves found a difference between results for short-run and long-run equilibria. Sultan (2011) found that both in the short run and long run, all examined variables are significant. However, in terms of elasticity, in the short run, imports were found to be inelastic with respect to all of three independent variables; while in the long run, imports were elastic with respect to income and inelastic with respect to relative prices and foreign reserves.

In a disaggregated estimation of Sri Lanka’s import demand, Tennakoon (2010) used relative import prices, income, and the availability of foreign exchange reserves as determinants of import demand of consumer goods, intermediate goods, and investment goods. The study found that in Sri Lanka, which receives its foreign exchange from export earnings, worker remittances, and disbursed foreign aid, the availability of such foreign exchange supported the import demand for intermediate and investment goods but not for consumer goods. After a considerable number of studies including foreign exchange reserves as a regressor in estimating import demand functions, Emran and Shilpi (2010) argued that the unavailability of data on the domestic market-clearing price of imports in developing countries causes the foreign exchange reserves variable to be the single determinant of the volume of imports (near identity as found in Emran and Shilpi (1996)). To overcome this issue, they estimate the LaGrange multiplier linked to the binding foreign exchange constraint expressed in relation to the ratio of a country’s income to the amount of available foreign exchange resources. Using a representative two-good model for India and Sri Lanka and the “virtual relative price” of imports, they find statistically significant and plausible results for income and price elasticities.

It is especially pertinent to include the foreign exchange reserve variable as a regressor in estimating the import demand function of Oman. Mazeri (1995) argued that such relationship is even closer in the case of oil-exporting developing countries where oil export receipts provide national income and foreign exchange backing. The study stated that an increase in foreign exchange receipts has (1) a significant income effect and (2) a relaxation of the foreign exchange constraint, thus causing imports to increase. The study then estimates Iran’s aggregate import demand model as function of real receipts from exports of goods and services (deflated by import prices), the relative price of imported goods, and real absorption. The empirical results confirmed the strong correlation between foreign exchange earnings from oil exports and Iran’s level of imports and provided evidence for the arguments that Iranian policymakers suppressed imports in times of low oil exports (1961/1962–1992/1993). Therefore, with the accumulation of foreign exchange reserves being involuntary in countries heavily reliant on oil exports such as Oman, the government may resort to alternative policies impacting demand for foreign exchange reserves in order to maintain adequate levels in times of shortage.

In a policy note, Alsayari (2019) of the Saudi Arabian Monetary Authority (SAMA) shared Saudi Arabia’s experience in foreign exchange reserves management and argued that reserve accumulation is not a policy choice. Indeed, as the Saudi Riyal is pegged to the US Dollar and as Saudi Arabia much like all other GCC countries is a monoline oil commodity exporter, Saudi Arabia’s foreign exchange reserve accumulation is involuntary as it is a direct result of the government’s oil revenues, which are a function of its output and the price of oil. While Saudi Arabia may exercise control over oil output, global oil prices remain unpredictable which historically meant that SAMA’s

policy approach was to “accumulate sufficient reserves when the oil price is strong so that they can be drawn down when the oil price is weak, without threatening the credibility of the riyal-dollar peg”. In addition to a standard import cover and a 100% mandatory currency backing, SAMA considers factors of “foreigners” remittances, a certain percent of broad money M3 (against a potential bank run), short-term debt cover (against a contingency of balance sheet crisis) and government debt servicing” when maintaining reserve adequacy.

3. Model specification and data

Following recent literature on the topic (A. C. Arize & Malindretos, 2012; Alam & Ahmed, 2010; Emran & Shilpi, 2010; Yin & Hamori, 2011; Zhou & Dube, 2011), we estimate the disaggregated import demand function for Oman using an Auto-Regressive Distributed Lag (ARDL) model with multiple requisite testing for long-term cointegration between the regressors. Stationarity tests of the data reveal stochastic properties that further justify the use of the ARDL model.

To analyze the determinants of Oman’s import, we specify the following equations:

$$TI_t = \beta_0 + \beta_1 Y_t + \beta_2 R_t + \beta_3 P_t + \varepsilon_{1t} \quad (1)$$

$$GI_t = \beta_0 + \beta_1 Y_t + \beta_2 R_t + \beta_3 P_t + \varepsilon_{2t} \quad (2)$$

$$SI_t = \beta_0 + \beta_1 Y_t + \beta_2 R_t + \beta_3 P_t + \varepsilon_{3t} \quad (3)$$

where TI_t , GI_t , and SI_t are total import, goods import, and services import at year t . Y_t is Oman’s real GDP at constant prices of base year 2010, R_t is foreign exchange reserves as net foreign assets of the CBO and P_t is GDP deflator as a proxy for domestic price data.¹ The government maintains foreign currency reserves in multiple destinations. However, the study uses CBO’s reserves because they are the largest share, and due to data transparency and availability. Furthermore, net instead of gross reserves are considered as the former is more conservative and less volatile indicator. All mentioned variables are in RO million and in the log form. A list of variable details can be found in Table A1 in the Appendix. The constructed time-series dataset for this study includes data for Oman for a period of 40 years from 1980 to 2019 on annual basis. Data are provided by the National Center for Statistical and Information (NCSI) and CBO, Oman.

4. Methodology

To estimate Equations (1), (2), and (3), first we test the integration properties of time series variables using ADF unit root test. Where most of macroeconomic variables are non-stationary and $I(1)$, the ARDL approach has solved the estimation of models with non-stationary data. The ARDL model is one of the common well-known approaches to estimate the equations when variables are $I(1)$ or combination of $I(0)$ and $I(1)$ processes. Thus, in order to examine the short-run and long-run relationship between variables the ARDL approaches is employed.

A general form of ARDL model of Equations (1), (2), and (3) are represented as follows:

$$\begin{aligned} \Delta TI_t = & C_1 + \sum_{i=1}^{l_1} \tau_{1i} \Delta TI_{t-i_1} + \sum_{i_2=1}^{l_2} \alpha_{1i} \Delta Y_{t-i_1} + \sum_{i_3=1}^{l_3} \alpha_{2i} \Delta R_{t-i_2} + \sum_{i_4=1}^{l_4} \alpha_{3i} \Delta P_{t-i_3} + \lambda_1 TI_{t-j} + \beta_1 Y_{t-j} \\ & + \beta_2 R_{t-j} + \beta_3 P_{t-j} + \varepsilon_t \end{aligned} \quad (4)$$

$$\begin{aligned} \Delta GI_t = & C_2 + \sum_{i_1=1}^{l_1} \tau_{2i} \Delta GI_{t-i_1} + \sum_{i_2=1}^{l_2} \delta_{1i} \Delta Y_{t-i_1} + \sum_{i_3=1}^{l_3} \delta_{2i} \Delta R_{t-i_2} + \sum_{i_4=1}^{l_4} \delta_{3i} \Delta P_{t-i_3} + \lambda_2 GI_{t-j} + \theta_1 Y_{t-j} \\ & + \theta_2 R_{t-j} + \theta_3 P_{t-j} + \varepsilon_t \end{aligned} \quad (5)$$

$$\Delta SI_t = C_3 + \sum_{i_1=1}^{l_1} \tau_{3i_1} \Delta SI_{t-i_1} + \sum_{i_2=1}^{l_2} \vartheta_{1i_2} \Delta Y_{t-i_2} + \sum_{i_3=1}^{l_3} \vartheta_{2i_3} \Delta R_{t-i_3} + \sum_{i_4=1}^{l_4} \vartheta_{3i_4} \Delta P_{t-i_4} + \lambda_3 SI_{t-j} + \mu_1 Y_{t-j} + \mu_2 R_{t-j} + \mu_3 P_{t-j} + \varepsilon_t \quad (6)$$

In Equation (4), the symbol Δ represents the first difference, while, l_1 , l_2 , l_3 and l_4 indicate the maximum lags of the dependent and independent variables. The optimal lag values are determined through the AIC information criterion. The parameter λ_1 represents the speed of adjustment for error correction, while the parameters β_1 , β_2 , and β_3 indicate the long-term effects of explanatory variables. The parameters α_{1i} , α_{2i} and α_{3i} represent the short-term effects of explanatory variables. To test the null hypothesis of no cointegration among variables in regression model (1), that is, when $\lambda_1 = \beta_1 = \beta_2 = \beta_3 = 0$, Pesaran et al. (2001) developed a modified F-test statistic using the bounds-testing procedure. The same procedure is applied to models (2) and (3).

5. Data description

We prepare statistical description of time series variables in panel A and ordinary bilateral correlation in panel B of Table 1. The results of three statistics Skewness, Kurtosis, and Jarque-Bera normality test indicate that the null hypothesis of normal distribution of time series variables are not rejected at 5% significant level.

Table 1. Statistical description of data

Panel A: Data description

	P	Y	IG	IS	IT	R
Mean	-0.531	9.562	7.878	6.698	8.150	7.264
Median	-0.682	9.646	7.629	6.550	7.923	6.867
Maximum	0.194	10.264	9.488	8.445	9.744	8.802
Minimum	-1.024	8.362	6.422	5.186	6.677	5.520
Standard deviation	0.424	0.500	0.981	1.119	1.012	1.001
Skewness	0.508	-0.542	0.269	0.234	0.257	0.335
Kurtosis	1.679	2.619	1.613	1.576	1.590	1.667
Jarque-Bera normality test	4.628	2.204	3.688	3.743	3.755	3.709
Probability	0.099	0.332	0.158	0.154	0.153	0.157
Observations	40	40	40	40	40	40

Panel B: Ordinary bilateral correlation

	P	Y	IG	IS	IT	
Y	0.698 (0.000)					
IG	0.907 (0.000)	0.922 (0.000)				
IS	0.891 (0.000)	0.927 (0.000)	0.989 (0.000)			
IT	0.905 (0.000)	0.925 (0.000)	0.999 (0.000)	0.994 (0.000)		
R	0.902 (0.000)	0.911 (0.000)	0.974 (0.000)	0.967 (0.000)	0.975 (0.000)	

Notes: Y: income (GDP), IG: import of goods, IS: import of services, IT: total imports and R: reserves. The figures in the parenthesis indicate the p-value of t-statistics of bilateral ordinary correlation.

The results of ordinary bilateral correlation between variables indicate expected relationship between variables and all of them are statistically significant at 1%.

6. Empirical results and discussion

As preliminary step, we test the stochastic properties of variables using ADF unit root test. We examine the integration degree of variables for the model with only constant and with constant and linear trend; and for two cases, level and first difference of variables. The results of integration order of the variables are reported in Table 2. The results of ADF unit root for model with constant indicate that all variables except real GDP are I(1) and real GDP is stationary in its level format. The results of ADF unit root test for model with intercept and linear trend are in line with the results model with intercept. For this case, all variables except real GDP are I(1) and real GDP is I(0). Thus the variables in the equations (1), (2), and (3) are combinations of I(1) and I(0) variables. With the results regarding the stochastic properties of the variables, the ARDL model is the best approach to estimate the short-run dynamics and long-run relationships among the variables in the equations (1), (2), and (3).

Table 3 presents the estimation results of Equation (1) obtained through the application of the ARDL cointegration technique. The results of F-bond test are prepared in panel A. The value of F test statistics equals 10.144, which is greater than the critical values at 1% significance level. The results indicate the null hypothesis of no cointegration is rejected at 1%; therefore; we can interpret the estimated long-run coefficients. The long-run coefficients indicate that real GDP and domestic prices have statistically significant long-run effect on total import demand while the net foreign assets do not have any significant effect on total import demand in the long run. According to the long-run coefficients, if real GDP grows by 10 percent, the total import of Oman will increase by 13.7% in the long run. If the domestic prices of Oman increase by 10%, its total import will increase by 15.49% in the long run.

The results of short-run dynamics indicate that among explanatory variables, only domestic price inflation have significant effect on total import. Ten percent increase in domestic price of Oman, will increase the total import demand by 8.2% in the short run. As can be seen, the short run elasticity of domestic price is less than long-run elasticity. In the short run, Oman's demand for imports is more inelastic than in the long run.

According to the estimates, the coefficient of error correction is 0.747, which is statistically significant at the 1% significance level. The result is that, due to exogenous shocks, the total imports of Oman have deviated from their long-run equilibrium level, and the dynamics of domestic prices in the short run help it to return to its long-run equilibrium level by 0.747 % per year. Seven specification tests are prepared in panel D, including the R-square, adjusted R-square, Breusch–Godfrey Serial Correlation LM test (F test statistics), ARCH heteroskedasticity test (F test statistics), Jarque–Bera test statistics (P-value), CUSUM, and CUSUM of squares stability tests.

According to the adjusted R-squared value, 56.3% of Oman's import demand can be explained by the explanatory variables. Breusch–Godfrey Serial Correlation LM tests the null hypothesis that the error terms follow an F-distribution and are not serially correlated. A p-value of 0.265 indicates that the null hypothesis was not rejected at the conventional cut-off point. To test whether the residuals are heteroskedastic, we use the ARCH test. The test statistic follows a conventional F-distribution, with a p-value of 0.336, indicating that the null hypothesis is not rejected. Jarque–Bera is applied to test the normality of the estimated residuals. As a result, the null hypothesis of normality of residuals is not rejected at a 1% significance level. Additionally, two stability tests, CUSUM and CUSUM of squares, indicate that the model is stable.

Turning to the results of the second equation, where import of goods is independent variable (Table 4). The result of cointegration test is represented in the Panel A of Table 4. The value of

Table 2. The results of ADF unit root test

Variables	Model with constant			First difference			Model with constant and trend		
	Level						Level		
	Test statistics	P-Value		Test statistics	P-Value		Test statistics	P-Value	
IT	-0.663	0.844		-5.382	0.000		-0.663	0.844	
IG	-0.905	0.776		-5.456	0.000		-0.905	0.776	
IS	0.088	0.961		-5.219	0.000		0.088	0.961	
Y	-4.462	0.001		-3.953	0.004		-4.462	0.001	
P	-0.265	0.921		-4.841	0.000		-0.265	0.921	
R	-1.085	0.712		-5.840	0.000		-1.681	0.741	

Notes: IT: total imports, IG: import of goods, IS: import of services, Y: income (GDP), P: prices and R: reserves. The optimal values of lags were selected using SIC criterion.

Table 3. Estimation results of total import model using ARDL methodology

Panel A: F-bond test				
Test statistics		Critical values		
			Lower Bound I (0)	Higher Bound I (1)
10.14446		10%	2.592	3.454
		5%	3.1	4.088
		1%	4.31	5.544
Panel B: long-run relationship				
Variable	Coefficient	Standard Error	t-Statistic	P-value
R	−0.226	0.156	−1.451	0.156
Y	1.372	0.187	7.351	0.000
P	1.549	0.214	7.223	0.000
Intercept	−2.467	0.893	−2.763	0.009
Panel C: Short-run dynamics				
Variable	Coefficient	Standard Error	t-Statistic	P-value
ΔP	0.820	0.133	6.167	0.000
CointEq(−1)*	−0.747	0.099	−7.541	0.000
Panel D: Specification test				
R-squared	0.575			
Adjusted R-squared 0.563				
Breusch–Godfrey Serial Correlation LM Test (P-value of F test statistics)				0.256
Normality test (P-value of Jarque–Bera test statistics)				0.803
Heteroskedasticity test: ARCH (P-value of F test statistics)				0.336
CUMSUM test				Stable
CUMSUM of squares test				Stable

Note: R: reserves, Y: income (GDP) and P: prices.

F-test statistics equals 8.627, which is greater than the critical values at 1% significance level. The results indicate that the null hypothesis of no cointegration is rejected at 1% therefore we can conclude the presence of long-run relationship between variables. The long-run results of Equation (2) are reported in Panel B. The results show that, income and local prices have significant positive effect on import of goods while there is no significant effect from net foreign asset on import of goods. According to the long-run results, if real GDP and domestic prices of Oman grow by 10 percent, the import of good will increase by around 13% in the long run.

The short-run results in Panel C show that the only variable that has a statistically significant effect on Oman's import of goods in the short run is GDP. The short-run coefficient of GDP implies that, 10 percent increase in GDP of Oman, will increase the demand of import of goods by 17%. The estimated coefficient of error correction term is 0.67 and statistically significant at 1% significance level. This implies that, if due to exogenous shocks, the total import of Oman is diverged from its long-run path; the dynamics of GDP in the short run help it to revert to its long run equilibrium level by speed of 0.67 per year.

The specification tests are reported in panel D of Table 4. The value of adjusted R-square is 0.59, which indicates the explanatory variables predict 59% variation of Oman's import demand of goods in the short run. In the Breusch–Godfrey Serial Correlation LM test, the null hypothesis is that the error terms are not serially correlated and that the test statistics have an F distribution. According to the P-value of the test statistics, the null hypothesis of no serial correlation is not rejected at conventional cut-off points. A null hypothesis of no heteroskedasticity of residuals is

Table 4. Estimation results of goods import model using ARDL methodology

Panel A: F-bond test				
Test statistics	Critical values			
		Lower Bound I(0)	Higher Bound I(1)	
8.627	10%	2.592	3.454	
	5%	3.100	4.088	
	1%	4.310	5.544	
Panel B: long-run relationship				
Variable	Coefficient	Standard Error	t-Statistic	P-value
R	−0.127	0.164	−0.774	0.445
Y	1.303	0.187	6.971	0.000
P	1.330	0.248	5.360	0.000
Intercept	−2.984	1.137	−2.624	0.013
Panel C: Short-run dynamics				
Variable	Coefficient	Standard Error	t-Statistic	P-value
ΔY	1.749	0.260	6.733	0.000
CointEq(−1)*	−0.664	0.096	−6.955	0.000
Panel D: Specification test				
R-squared	0.590			
Adjusted R-squared	0.579			
Breusch–Godfrey Serial Correlation LM Test (P-value of F test statistics)				0.510
Normality test (P-value of Jarque–Bera test statistics)				0.924
Heteroskedasticity test: ARCH (P-value of F test statistics)				0.261
CUSUM test				Stable
CUSUM of squares test				Stable

Note: R: reserves, Y: income (GDP) and P: prices.

tested using the ARCH test. Test statistics follow a conventional F distribution. This p-value indicates that the null hypothesis is not rejected. Jarque–Bera tests the normality of the estimated residuals. As a result, the null hypothesis of residual normality is not rejected at the 1% significance level. Two stability tests of CUSUM, and CUSUM squares indicate the non-rejection of null hypothesis of stability of estimated regression model.

The result of estimated service import model is presented in Table 5. The results of cointegration test in Panel (A) shows the presence of long-run relationship between variables at 5% significance level. Similar to the previous models, GDP and domestic prices have significant positive effect on demand of imported services to Oman. A 10 percent increase in GDP and domestic prices, will promote demand of import of services in Oman by around 22 and 14 percent, respectively. In the services import model, net foreign assets do not have any statistically significant effect on the import of services to Oman. The estimated coefficient of error correction term is 0.3 and statistically significant at 1% significance level. This implies that, convergence towards long run equilibrium level will be around 0.3 percent per year. The diagnostic tests of the third model (service import model) are presented in panel (D) Table 5. Similar to the total import and goods import models, the services import model also passes the specification test (panel D).

Results of the effect of income and domestic prices on imports are reasonable. Economic growth in Oman is largely driven (Al-Abri et al., 2019) by government expenditure which (1) raises levels of individuals' income in the country through government employment and (2)

Table 5. Estimation results of service import model using ARDL methodology

Panel A: F-bond test

Test statistics	Critical values		
		Lower Bound I (0)	Higher Bound I (1)
4.392	10%	2.592	3.454
	5%	3.100	4.088
	1%	4.310	5.544

Panel B: long-run relationship

Variable	Coefficient	Std. Error	t-Statistic	P-value
R	−0.428	0.393	−1.089	0.284
Y	2.278	0.526	4.328	0.000
P	1.409	0.537	2.625	0.013
Intercept	−11.193	3.007	−3.722	0.001

Panel C: Short-run dynamics

Variable	Coefficient	Std. Error	t-Statistic	P-value
ΔR	0.011584	0.099243	0.116724	0.9078
CointEq(−1)*	−0.302	0.061	−4.980	0.000

Panel D: Specification test

R-squared	0.416
Adjusted R-squared	0.383
Breusch–Godfrey Serial Correlation LM Test (P-value of F test statistics)	0.407
Normality test (P-value of Jarque–Bera test statistics)	0.358
Heteroskedasticity test: ARCH (P-value of F test statistics)	0.728
CUMSUM test	Stable
CUMSUM of squares test	Stable

Note: R: reserves, Y: income (GDP) and P: prices.

propels investment expenditure. Both effects are expected to have a positive effect on the size of imports as high income translates into increased import of consumption goods while investment expenditure translates into increased import of capital goods and machinery. These results are consistent with the literature on import elasticities relative to prices and income where income was found to have a positive and significant impact on import demand (Faini et al., 1988; Kolluri & Torrisi, 1987; Sultan, 2011; Tennakoon, 2010) while relative prices of imports to domestic prices had a significant negative impact on import demand (A. Arize & Afifi, 1987; Sultan, 2011; Tennakoon, 2010). On the other hand, the results of the absence of a foreign reserves effect are not surprising. Theoretically, a country that receives and maintains a large amount of foreign reserves by virtue of export earnings is expected to derive a high propensity to import from such reserves. However, for the case of Oman as all other GCC countries, Oman is a monoline oil commodity exporter and its Riyal is pegged to the US Dollar. Consequently, Oman's foreign exchange reserve accumulation is involuntary as it is a direct outcome of the government's oil revenues, which are determined by oil output and price. To maintain the riyal-dollar peg and given the exogeneity of oil prices to Oman, maintaining an adequate level of reserves is vital, regardless of the level of imports. Some of the results of this study are inconsistent with those of previous literature on other countries where foreign exchange inflows and international reserves were found to have a strong and positive impact on import demand. Our results are closest to Sultan (2011) in which, in the short run, imports were found to be inelastic with respect to all main variables in the model: income, relative prices and foreign reserves.

7. Conclusion and policy implications

This study aims to understand the driving factors of import demand function for the Omani economy in the long and short term. The study estimates an aggregate and disaggregate import demand function as a function of domestic income, domestic prices, and the level of foreign exchange reserves. Specifically, this study employs Autoregressive Distributed Lag (ARDL) model to investigate the impact of real income, domestic prices, and foreign exchange reserves on aggregate and disaggregate import demand function in Oman for both long run and short run using time series data during 1980–2019. Generally, findings indicate the importance of reactivating the linkage between foreign exchange reserve and imports mechanism given the significance of such indicators at country level. Foreign reserves serve as a liquidity constraint for imports, the results of no influence found in this study could indicate a leakage in the flow path of CBO reserves to imports. Moreover, the weak linkage could be attributed to currency peg stabilization and varying sources of foreign currency in the market. To better identify the linkage, there is a need for a more transparent data of other suppliers of foreign currency as well as the level of foreign exchange reserves at all governmental entities.

Considering the impact of imports demand on foreign reserves, it is acknowledged that trends and shocks in the domestic demand for imports are bound to have an impact on foreign reserves, especially for a country with a high level of imports such as Oman. Indeed, our findings do not undermine the importance of maintaining reserves at an adequate level to shield the economy against such shocks. Furthermore, policies aimed at mitigating imports at sustainable levels are of paramount importance given our need to maintain reserves at an adequate level to defend the peg.

The results of our estimated import demand functions for Oman with varying significance and elasticities in the short and long runs are quite interesting. In the long run, domestic prices and income have significant effects on the demand for imports in all estimated equations (aggregate imports, import of goods, import of services). However, the level of foreign exchange reserves is insignificant in all estimated models. In the short run, total imports were significantly affected by domestic prices only, albeit with less elasticity than in the long run. Whereas, demand for goods import is considerably affected by income in the short run. The level of foreign exchange reserves is found to have insignificant impact on all considered models as well as in the short and long term. In addition to maintaining the credibility of riyal-dollar peg, this finding could be explained by the presence of leakages during the movement of foreign exchange reserves from receipt to expenditure on imports, as well as the Sultanate's lack of strategic policy action in saving foreign exchange reserves by mitigating imports. First, the government of Oman does not place all US dollar export receipts as reserves with the Central Bank of Oman, but rather distributes some amounts in other reserve funds. This means that a considerable increase in overall foreign exchange reserves does not necessarily mean a considerable increase in CBO net foreign assets (which is the measure used to represent the level of foreign exchange reserves in this study). Hence, the level of imports would not be directly correlated with the level of reserves, as represented in the model due to that distortion from 1980 to 2014. However, this explanation is not applicable to the post-2014 time period during which the crash in oil prices globally and the liquidity crunch locally drove the consolidation of a number of reserve funds under the CBO. Second, commercial banks, particularly foreign banks, in Oman receive supply of foreign currency from their international parent bank, which, in turn, could increase imports without impacting reserves at CBO. Third, having historically maintained high levels of foreign exchange reserves that are well beyond the required minimum to defend the peg with the USD, policymakers in the Sultanate took minimal policy action in terms of mitigating imports to maintain adequate levels of foreign exchange. Given our high dependence on imports for consumption, especially for necessities, compression of imports was not a policy priority in the short run for policymakers to mitigate the erosion of foreign exchange reserves post-2014, but heavy borrowing from external sources.

As a policy implication of this research paper, more profound and strategic efforts need to be made in order to contain the size of imports demanded by the Sultanate. With domestic prices being a significant determinant of imports of all kinds, competition and efficient production of local goods and services should be further encouraged, especially with respect to issues such as food security. Not only would this type of policy reduce the country's high dependence on imports and improve its trade balance, it would ease the pressure on depleting foreign exchange reserves that are currently crucial for defending the currency peg and servicing of sovereign external debt. The statistically significant effect of income on the demand of imports in the Sultanate reassures the need for the policies outlined above, as Oman is a developing economy with relatively high levels of GDP growth. Furthermore, the composition of imports should be shifted more towards investment goods and services instead of consumption as they guarantee higher benefit for the economy in the long run.

Future research is needed to shed light on other variables that may influence the level of foreign exchange reserves or examine the impact of COVID-19 pandemic which will make the findings more useful in the post-pandemic Oman economy. Moreover, it is important to study further the reasons behind absence of linkage between foreign exchange reserves and import levels for better import demand management and reserve centralization or allocation across the relevant government entities. The limitation of this study is that it has taken into consideration the domestic prices only due to data inconsistency, although imports are influenced more by relative prices rather than the domestic prices alone based on the literature.

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Note

1. Since the dataset of consumer price index is not available for long time for Oman, we use GDP deflator as a proxy for domestic prices.

Data availability statement

The data that support the findings of this study are available on request from the data owner—The Central Bank of Oman. The data are not publicly available due to privacy restrictions.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix

Table A1. List of variable details

Abbreviation	Variable	Unit	Form
<i>Y</i>	GDP at Constant Prices	Billions of Omani Rials	Log
<i>GI</i>	Imports of Goods		
<i>SI</i>	Imports of Services		
<i>TI</i>	Total Imports		
<i>R</i>	CBO Net Foreign Assets		
<i>P</i>	Prices (GDP deflator as proxy)	Index	



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