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Estimating Sierra Leone's Aggregate Import Demand Function Under Binding Foreign Exchange

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Abstract

The primary objective was to evaluate the extent to which foreign exchange restraints import demand in Sierra Leone. Using time series data from 1980 to 2020, this study determined Sierra Leone's import demand function by including foreign exchange constraints in a structural model developed by Emran and Shilpi (2010). The model compensated for both short-run and long-run links by employing an ARDL bounds-testing technique with an error-correcting mechanism. The result supports evidence of long-run cointegrating relationship between import demand and its determinants. In the short-run, domestic consumption, scarcity premium, and trade liberalization were found to be significant predictors of Sierra Leone's actual import demand. However, in the long-run, only domestic consumption was found to be significant. Typically considered as the key determinants of import demand, real effective exchange rate was insignificant in both the short and long-term. Scarcity premium was also found to be insignificant in the long-run. Therefore, the result indicates that Sierra Leone has no short-term foreign exchange constraints. This could be partially explained by the Bank of Sierra Leone's strategy over the years of providing foreign currency to the private sector to assist in the importation of essential goods. The key finding of the study is that Sierra Leone's import demand is not constrained by a shortage of foreign currency.

Keywords: import demand, foreign exchange constraint, ARDL, Sierra Leone

1. Introduction

In recent decades, especially since 1990s, both academics and policymakers have shown a significant interest in the relationship between the foreign exchange generation capabilities, capital formation, and import capacity of emerging countries. The justification for this is the neoclassical growth hypothesis, which holds that capital production promotes economic growth. However, developing countries were unable to generate enough capital to fund the rapid growth of their economies' stock of physical assets since their saving rates were insufficient. Thus, they have relied extensively on foreign investment, raw materials, and replacement parts imports to fund their growth and development programs.

There has been a growing interest in the empirical literature in trying to understand what motivates imports in both economically developed and less developed nations. This is so because of the critical role imports play in global trade and development. In response, many models of import demand have been developed, the majority of which rely on a wide set of assumptions in order to capture the essence of import behaviour. According to standard trade models, imports increase as domestic capacity increases and decrease as relative prices rise. It is also assumed that the importing country has unrestricted access to foreign currency (see Goldstein and Khan (1985), Sinha (1997), Oskooee (2005), Omotor (2010), etc.).Despite the success of the traditional import models in describing import behaviour in developed countries, several authors have acknowledged that these models are largely irrelevant in the context of least developed countries. Internal structural rigidities (such as foreign exchange limits, policy failures, and borrowing constraints) and external shocks (such as commodity price fluctuations, weather shocks, global recessions, etc.) have been identified as the factors preventing these economies from importing at optimal levels. As a result, there is a growing consensus in the scholarly literature that empirical studies of developing economies must use import demand models that take into account foreign exchange constraints (Emran and Shilpi, 2010). Given that it accounts for both binding foreign exchange constraints and the near identity problem, this model is vastly superior for use in a developing economy like Sierra Leone.

Figure 1 shows that for the better part of the last three decades, Sierra Leone's import of goods and service has tracked the growth rate of gross domestic product indicating that the country had relied heavily on imports to meet domestic demand. Thus, there is a strong relationship between the growth rate of gross domestic product (GDPGR) and the

imports of goods and services as a percentage of Gross Domestic Product (IMPT/GDP), demonstrating the high import content of Sierra Leone's growth dynamics.

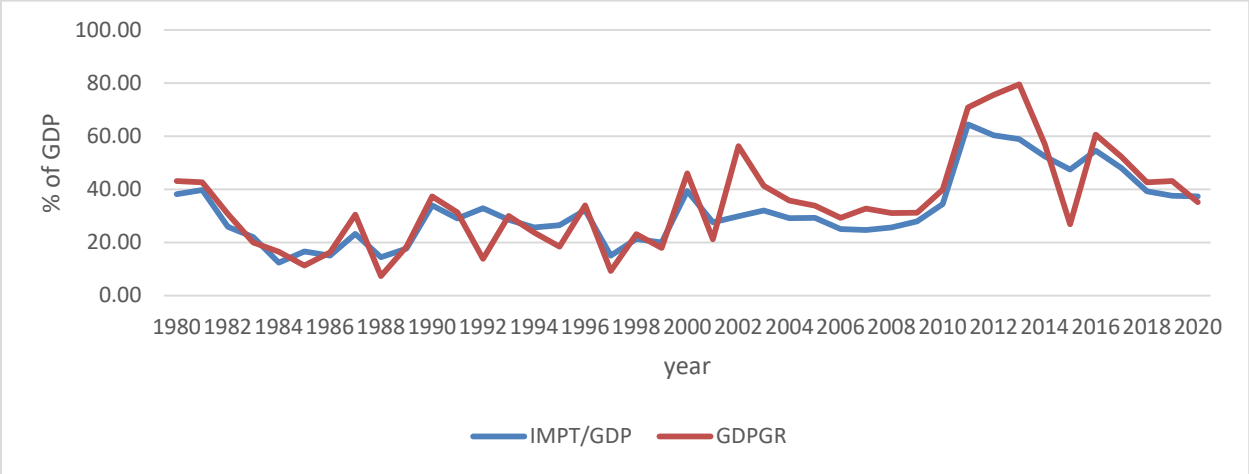

Figure 1. Trends in Real Gross Domestic product growth and Imports of Goods and Services as a percentage of Gross Domestic Product 1980-2020

As indicated in figure 2, the widening external balance (CA/GDP) on goods and services over the recent decades is mostly attributed to the combined effects of significant growth in imports that outpaced the expansion in exports. The imports of goods and services as a percentage of the gross domestic product(IMPT/GDP) increased from 22.52 per cent between 1980 and 1989 to 26.50 per cent between 1990 and 1999 to 29.06 per cent between 2000 and 2009 to 48.60 per cent between 2010 and 2020. In comparison, exports as a percentage of gross domestic product (EXPT/GDP) increased from 19.47% between 1980 and 1989 to 22.84% between 1990 and 1999, before decreasing to 14.20% between 2000 and 2009 and growing by 22.00% between 2010 and 2020. The year commencing in 2011 was marked by a severe drop in the external balance, as exports fell and imports rose sharply. This period coincided with the mobilization phase of the iron ore mining operation, which resulted in significant imports of machinery and transportation equipment. The analysis finds that Sierra Leone does not generate enough foreign currency to support the importation of raw materials, consumer goods, and key services that are necessary for economic expansion. This is cause for concern given Sierra Leone's aspiration to achieve middle-income status by 2035.

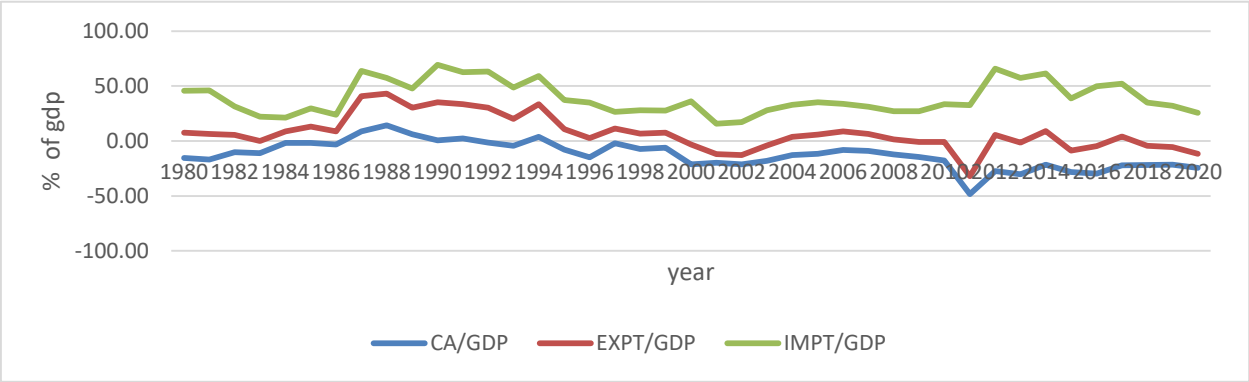

Figure 2. Trends in Sierra Leone's imports, exports and External Balance on goods and services as a % of GDP-1980-2020

Given this trend, estimating Sierra Leone's import demand function in the context of a foreign exchange constraint is crucial. While there is a plethora of empirical studies on the import demand function in both developed and developing nations, studies specific to Sierra Leone remains scanty. Only Kebbay (2000) and Batholomew (2010) have tried to estimate the import demand function for Sierra Leone, and they both use the traditional specification of the import demand function, which ignores the foreign exchange constraint that are typical of a small, open economy like Sierra Leone.

In view of the aforementioned, this study departed significantly from the model specifications of previous studies on Sierra Leone by modelling the import demand function in Sierra Leone, incorporating a binding foreign exchange constraint. To achieve this objective, we employ the ARDL modelling technique developed by Pesaran, Shin, and Smith

(2001) on time series data from 1980 to 2020. Understanding these dynamics will enable policymakers to have a better understanding of fluctuations in the balance of payments and terms of trade, so assisting them in deciding on short- and long-term development strategies and trade-related actions, such as import demand management policy. In addition, a thorough comprehension of import behaviour would illuminate Sierra Leone's foreign exchange policy.

The foreign exchange scarcity premium (the foreign exchange restriction variable) was shown to be statistically significant at the 5% level of significance, but with a positive sign. This contradicts the findings from other developing economies, where foreign exchange restraints are prevalent. The empirical findings also demonstrated the existence of a long run cointegration between the real import demand and its determinants. Long-term, with the exception of domestic consumption, all the other factors - real effective exchange rate and scarcity premium - have the correct signs, but their influence on actual imports of goods and services was statistically negligible. In the short run, however, domestic consumption, scarcity premium, and trade liberalization dummy were found to be statistically significant in explaining real import demand in Sierra Leone, except for the real effective exchange rate.

From the above introduction, the remainder of the work is structured as follows: The second section examines the theoretical and empirical literature on import demand. The study introduces the data, the theoretical framework and model specification, and the ARDL estimation technique established by Pesaran et al (2001) in section 3's methodology part. Section 4 contains the results and analysis. Finally, we provide the conclusion in Section 5.

2. Literature Review

2.1 Theoretical Review

The theoretical underpinnings for this analysis of the import demand function leveraged on international trade theory. The theoretical literature has been dominated by imperfect substitution, Keynesian, and neoclassical theories. These theories highlight the role that national income, consumer prices, and exchange rates play in setting global trade patterns (Hong, 1999).Effects of scale economies, product differentiation, and monopolistic competition on international trade are the primary focus of the imperfect substitution hypothesis. There are many economic models, but the Marshallian, Chamberlin, and Cournot models are the most accurate in capturing the complexities of international trade and the consequences of imperfectly competitive markets.

The Chamberlin approach, in contrast to the Marshallian one, assumes that new firms can enter the market and differentiate their products from those of existing firms, thereby eliminating any monopoly profit at the industry level (Dixit and Norman, 1980).The Cournot model takes into account the outputs of other firms as a given and assumes that firms are not perfectly competitive. All three of these market configurations stand to gain from a liberalisation of international trade in terms of their overall size, the prices they charge, and the amount of product and services they trade (Dixit and Norman, 1980).The new trade theory proposes a different relationship between trade and income because the importance of income in determining imports goes beyond that stated in neoclassical import demand functions, in which income just affects purchasing power. The buyer is assumed to maximise utility within a given budget in both the normal demand theory and the imperfect substitution theory. In other words, the import demand function accounts for the importing nation's income, the cost of the imported good, and the cost of domestically produced substitutes (Goldstein and Khan, 1985). Similar consideration is given in the Keynesian hypothesis which analyzes the impact of macroeconomic factors such as inflation and unemployment on import demand. As a result, import demand can be explained in terms of income and price, implying that employment is elastic and capital flows can be adjusted to account for changing economic conditions (Englama, Oputa, Sanni, Yakub, Adesanya, and Sani, 2013).The Heckscher-Ohlin (H-O) framework, which is based on Ricardo's seminal work, is closely associated with neoclassical thought. According to this theory, countries import the types of products for which they have the lowest factor endowment because of differences in the relative abundance of different factors of production (Englama et al., 2013).Therefore, the theory suggests that the manufacturing costs of a given commodity in the importing country play a significant role in determining import demand. Effects of relative import price on international trade volume and direction are the primary focus of the comparative advantage (Shuaibu and Fatai, 2014).Since the theory assumes full employment and output predetermined, it ignores how income fluctuations affect trade (Bathalomew, 2010).

2.2 Empirical Review

Using the recently developed import demand equation derived from the dynamic-optimizing intertemporal approach, Tang (2003) examined the long-run relation of the aggregate import demand function for the 18 economies of the Organization of Islamic Conferences (OIC) for the years 1960-2000.The bounds test indicated that for 10 of the 18 countries in the sample, import demand, domestic real activity, and relative prices were all cointegrated. The estimated price and domestic activity variables were generally inelastic over the long term. In estimating an import demand function for Pakistan, Arize, Malindretos, and Grivoyannis (2004) utilised multiple cointegration methods while imposing long-run income homogeneity and accounting for foreign exchange reserves. Real imports, real income,

relative import prices, and real foreign exchange reserves were all found to be cointegrated. Additionally, the study uses stability tests for cointegrated systems proposed by Hansen to show that only when foreign exchange reserves and long-run unit-income homogeneity are taken into account does a long-run equilibrium relation with a constant parameter arise for Pakistan. As with the long-run static model, the short-run dynamic model was shown to be internally consistent and data coherent. In a research for Taiwan, Chen (2008) applied the cointegration technique on 1976Q1-2004Q4 time series data. This study revealed that import demand is responsive to income and relative import price fluctuations. Additionally, it was found that the effect of income is greater in the short term than in the long-run. Using empirical data, Oteng-Abayie et al. (2009) examined an import demand function for a small open economy such as Ghana from 1970 to 2002. The data revealed a long-term relationship between real exchange rates, GDP, and import of goods. This study demonstrated that Ghana's imports are mostly determined by its actual income (GDP). In addition, the results demonstrated that economic growth (real GDP) and depreciation of the local currency can stimulate an increase in import demand. In addition, the results indicated that shocks to imports, real GDP, and the real exchange rate play a substantial role in explaining variance decomposition of each of these variables over a range of time horizons and magnitudes. In particular, the evidence indicates that around 65 percent, 95 percent, and 80 percent of short-term shocks to real exchange rates, merchandise imports, and GDP are related to their own shocks. Omotor (2010) used annual time series data to investigate Nigeria's import demand function using an error-correction econometric model. The analysis showed that imports are linked to income and relative pricing in a stable, long-term relationship. Moreover, the study finds that liberalisation, which began in 1986, had a small but significant effect on import demand in Nigeria, and that real income (GDP) is the primary factor influencing import demand, while relative pricing has less of an impact. To estimate an import demand function for Sri Lanka and India, Emran and Shilpi (2010) developed a structural econometric model of a two-product representative agent economy that incorporates a binding foreign exchange restriction at administered prices. Using an ARDL cointegration approach to estimate income and price elasticity, they determined, contrary to the previous literature, that price and income elasticity estimates for India and Sri Lanka have the correct signs, strong statistical significance, and suitable magnitudes. Using the cointegration method developed by Johansen, Zafar Ahmad Sultan (2011) investigates the aggregate import demand function for India. Long-term equilibrium exists between real imports, real income, the relative price of imports, and real foreign currency reserves, according to this finding. Long-term analysis reveals that imports are elastic with respect to income but inelastic with respect to relative price and foreign reserves. We also find a significant short-term relationship between import, income, relative price, and foreign exchange reserves. In the short-run, import is found to be inelastic with respect to each of these variables. Butts et al. (2012) explores the link between import demand and a set of foreign exchange supply channel factors across a forty-year time series for Guyana. Using single equations and vector autoregression (VAR) frameworks, coefficients are calculated to determine both the short-run and long-run correlations among import demand, gross national income, and channel factors. The channel variables consisted of explanatory external-linkage variables, such as official foreign aid, exports/imports, the exchange rate, and foreign exchange reserves. The results indicate a long-term association between import demand and channel factors. Using quarterly data from 1970 to 2011, Englama et al. (2013) explored objectively the causes behind Nigeria's high import costs. The authors calculated the aggregate import demand function for Nigeria via the Autoregressive Distributed Lag (ARDL) method. The estimated result demonstrates that the coefficients of external reserves, domestic consumer prices, income level, and exchange rate are all statistically significant, showing that these variables play a significant role in determining Nigeria's level of imports. Short-run elasticity testing found that Nigeria's aggregate import demand was income and price elastic. Rashid and Razzaq (2013) estimated a structural import demand function for Pakistan prior to trade liberalization using ARDL and DOLS techniques. They identified substantial evidence of a long-term stable relationship between the model's variables and that the estimations for price and income elasticity have the correct sign and are statistically significant. The negative and statistically significant coefficient of the scarcity premium variable indicates that imports in Pakistan are subject to a binding foreign exchange limitation. Similarly, Aziz (2013) computed the aggregate import demand function for Bangladesh. Several co-integration estimation methods and the error correction mechanism were applied by him. The outcome demonstrates that real income, relative import prices, foreign exchange reserves, and export demand are statistically significant over the short and long terms. Shuaibu and Fatai (2014) in estimating an import demand function for Nigeria, revisited the standard import demand function that incorporates the sensitivity of external reserves to oil revenue inflows. They study captured the impact of regime shift on the long-term reliability of Nigeria's import demand function. The study found a strong correlation between import demand and its drivers over the long-term. It also emerged from the study that there is a unidirectional causation between shifts in relative prices, oil revenue inflows, and the volatility of international reserves, and Nigerian import demand. However, a bidirectional causality was found when the authors accounted for regime shift, indicating the relevance of regime shifts in determining the predictability of Nigeria's import demand. Muhammad and Zafar (2016) estimated the long-run and short-run coefficients of Pakistan's import demand function from 1973 to 2013 using the Autoregressive Distributed Lag model. They introduced important factors such as final consumption expenditures, investment expenditures, government consumption

expenditures, exports, foreign direct investment, currency rate, and import. The result demonstrates that the import has both a long-term and a short-term relationship with the independent variables under consideration. In another study, Ibrahim (2017) adopted the ordinary least squares and error correction model to estimate an import demand function for Egypt. The study was based on an annual data covering the period 1970-2014.The results indicated that real gross domestic product has a positive and significant impact on import demand in both the long-run and short-run. However, a negative and significant relationship was established between import demand and real effective exchange rate. Inflation and international reserves were found to positively affect import demand in the long-run, but they have no impact on import demand in the short –run. Similarly, Nomfundo et al. (2018) used an auto regressive distributed lag modelling approach with data for the period 1985 and 2015 to estimate an import demand function for the South Africa economy. To achieve the study objectives, they adopted four models which was a departure from earlier studies that utilised a single model. They authors concluded that import demand in South Africa was influenced positively by trade liberalisation policy, investment spending, and gross national income in the long-run. In the short-run, gross national income, investment spending and consumer spending were identified as positively influencing import demand, while government spending had a negative effect on import demand in South Africa. Estimates of the import demand function for Cote d'Ivoire was undertaken by Yaya (2019) for the years 1980-2017. The empirical evidence suggests a long-term cointegrating relationship between Côte d'Ivoire's imports, income, domestic prices, and import prices. In the short and long run, imports was found to be impacted positively by real income and domestic prices but negatively by international prices. When compared to changes in income and import price, the response of import demand to changes in domestic prices is much more pronounced. According to the data, the relative price formulation of the import demand function for Cote d'Ivoire is flawed because the assumption of price homogeneity did not hold.

While there is an abundance of study at the international level, there is insufficient research on Sierra Leone's aggregate import demand. For instance, Bathalomew (2010) contends that the large influence of expenditure components on import demand indicates that the exchange rate policy is ineffectual at affecting import demand. Using time series data from 1966 to 1996, Kebbay (2000) approximated the import demand function for Sierra Leone utilizing the Engle, Granger, and Johansen cointegration techniques. Consistent with the standard definition of the import demand model, the foreign exchange limitation was captured by export receipts in this study. He determined that foreign exchange availability had the greatest impact on import demand in Sierra Leone.

3. Theoretical Framework, Model Specification and Data

3.1 Theoretical Framework and Model Specification

The rational expectation permanent income model is used as the theoretical framework for estimating the import demand function for a small open economy like Sierra Leone. In this model, economic agents' long-term expenditure is determined by their predicted long-term average income. The model has been modified to account for the binding foreign exchange constraint. We assume for analytical purposes that the representative agent consumes domestically produced products designated by H_t and imported goods denoted by M_t. To account for a binding foreign exchange restriction in the import demand function, the optimization problem will be subject to two constraints: one for general asset accumulation and the other for foreign exchange. As a result, the dynamic optimization issue for the representative agent associated with the above arguments is summarized as follows:

$$Max_{[H_t, M_t, A_t]} V = E\int_{t=0}^{\infty} e^{-\delta t} U(H_t, M_t) dt \quad \text{---------- (1)}$$

Subject to:

$$\overset{*}{A} = r A_t + \tilde{Y} - H_t - P_t H_t \quad \text{---------- (2)}$$

$$P_t M_t \leq F_t \quad \text{---------- (3)}$$

Where P_t =relative price of imports

A_t =assets

$\tilde{Y}$ = labor income

F_t =total amount of foreign exchange available

r =constant real interest rate

δ =discount rate; the higher the discount rate, the more impatient the representative agent will be.

$\overset{*}{A} = \frac{dA_t}{dt}$ is a time derivative

To solve the representative agent's optimization problem we use the Lagrange function:

$$L = U(H_t, M_t) + \lambda_t\left[rA_t + \tilde{Y}_t - H_t - P_t M_t\right] + \mu_t\left[F_t - P_t M_t\right] \text{---------- (4)}$$

In this framework, H_t and M_t are control variables, A_t is a state variable and λ_t is a costate variable and μ_t is the Lagrange multiplier for the binding foreign exchange rate constraint. The first order conditions for the above optimization problem are:

$$U_H = \frac{\partial L}{\partial H} = \lambda_t \text{---------- (5)}$$

$$U_M = \frac{\partial L}{\partial M} = P_t\left(\lambda_t + \mu_t\right) \text{---------- (6)}$$

$$\dot{\lambda} = -\frac{\partial L}{\partial A} = \lambda_t(\delta - r) \text{---------- (7)}$$

Therefore, we assume there is no Ponzi scheme in order to strengthen the model's resolute foreign exchange constraint condition (Senhadji, 1998).This fundamental assumption safeguards against the representative agent being able to finance imports indefinitely through borrowing foreign currency.

Following Clarida (1994), it is assumed that the utility function for the representative agent is an addilog utility function:

$$U\left(H_t, M_t\right) = C_t \frac{H_t^{1-a}}{1-a} + B_t \frac{M_t^{1-\eta}}{1-\eta} \text{---------- (8)}$$

Where C_t and B_t are random, strictly stationary shocks to preference. Substituting equation (8) in (4) gives:

$$L = C_t \frac{H_t^{1-a}}{1-a} + B_t \frac{M_t^{1-\eta}}{1-\eta} + \lambda_t\left[r A_t + \tilde{Y}_t - H_t - P_t M_t\right] + \mu_t\left[F_t - P_t M_t\right] \text{---------- (9)}$$

From equation (9):

$\frac{\partial L}{\partial H} = C_t H_t^{-a} - \lambda_t = 0$, therefore

$$C_t H_t^{-a} = \lambda_t \text{---------- (10)}$$

$$\frac{\partial L}{\partial M} = Bt\, M t^{\eta} - Pt\, \lambda t - \mu_t\, Pt$$

$$Bt\, M t^{-\eta} = Pt\, \lambda t\left(1 + \mu_t^{*}\right) = \lambda t\, Pt^{*} \text{ ---------- (11)}$$

Where $\mu_t^{*} = \frac{\mu_t}{\lambda_t} = \frac{\mu_t}{U_H}$ is the scarcity premium and P_t^{*} is the scarcity price

Subsitituting equation (10) into equation (11) and taking logarithms gives:

$$b_t - \eta\, m_t = c_t + p_t - a\, h_t + \ln(1 + \mu_t^{*}) \text{ ---------- (12)}$$

$$Y^{*} = H + P^{*} M \text{ ---------- (13)}$$

$$ht = \ln(Y_t^{*} - P_t^{*} M t)$$

$$\equiv \ln(Y_t - Pt\, M t) \text{ ---------- (14)}$$

$$mt = \frac{a}{\eta}\ln(Y_t - Pt\, M t) - \frac{1}{\eta}\, p_t - \frac{1}{\eta}(1 + \mu_t^{*}) + \xi_t \text{ ---------- (15)}$$

Where $\xi_t = \frac{1}{\eta}(b_t - c_t)$ is the composite preference shock. Without foreign exchange constraint in equation (15), μ_t^{*} is zero. Thus, equation (15) becomes the traditional import demand function. However, the inclusion of the foreign exchange constraint in equation (15) leads to near identity problem. To address the identity problem, we use real total expenditure (GDP+Import-Export)/Foreign exchange instead of μ_t^{*} and the new variable Z_t^{*} is included in the equation. There is no direct effect of Z_t on import demand, but through the medium of μ_t^{*} and they are positively related. Since $\frac{\partial \mu_t^{*}}{\partial Z_t} \succ 0$, import demand will be negative with Z_t. Therefore, $\frac{\partial Mt}{\partial Zt} = \frac{\partial Mt}{\partial \mu_t^{*}} * \frac{\partial \mu^{*}}{\partial Zt} \prec 0$

Finally; the following equation is derived for estimating import demand function:

$$mt = \frac{a}{\eta}\ln(Y_t - Pt\, M t) - \frac{1}{\eta}\, p_t - \frac{\theta 1}{\eta} Z t^{*} + \xi_t \text{ ---------- (16)}$$

$$= \pi 1^{\ln(Yt - Pt\,Mt)} - \pi 2\, p_t - \pi 3 Z\overset{*}{t} + \xi_t$$

In light of above theoretical framework and adopting the structural model recently developed by Emran and Shilpi (2010) that incorporates a binding foreign exchange constraint, the aggregate import demand equation can be written as follows:

$$LRIMPT\,t = \alpha 0 + \alpha 1\, LDCONS\,t + \alpha 2\, LREERt + \alpha 3\, LSCA\_PRE_t + \phi Dummy + \mu_t \text{ ---------- (17)}$$

Where LRIMPT is the logarithm of real import of goods and services, LDCONS is the logarithm of domestic consumption, LREER is the logarithm of real effective exchange rate, LSCA_PRE is the logarithm of scarcity premium and dummy is the trade liberalization dummy and μ_t is the error term.

3.1 Estimation Technique

Since we wanted to make sure that no variable is integrated to the second order (I(2)), we began the empirical analysis by looking into the stationarity properties of the variables. Including I(2) variable in the model in the ARDL framework would invalidate the F-Statistics in the bounds test, this is incredibly important. To this end, we used the Phillips-Perron (PP) and Augmented Dickey Fuller (ADF) stationarity tests. Once the non-existence of an I(2) variable is established, we then used the bounds testing method applied to the ARDL model proposed by Pesaran, Shin, and Smith(2001) to look for evidence of long-run cointegration between real imports and the factors that affect it. In general, the bounds testing approach to cointegration has some advantages that makes it more attractive than the traditional approaches to estimating cointegration. The first benefit is that it works well with both stationary and non-stationary explanatory variables (Pesaran et al., 2001). Second, the problems associated with apriori testing of variables for unit roots are avoided (See Maddala and Kim, 1998).Furthermore, the unrestricted-error-correction model (UECM) and bounds test can be used to account for the small sample bias of cointegration analysis, as mentioned by Mah (2000) and Pattichis (1999). Due to the limited size of the data set in our study, the conventional Engle-Granger (1987) and Johansen (1990) approaches for testing cointegration would yield less trustworthy results than the alternative ARDL approach.

In the next step, we used the Ordinary Least Squares (OLS) estimator to estimate the bounds test in light of the estimated conditional ARDL-ECM equation (Pesaran, Shin and Smith, 2001).The aggregate import demand function is described by the following conditional ARDL-ECM equation:

$$\begin{aligned}\Delta LRIMPT_t &= \alpha 0 + \alpha 1\, LRMPT_{t-1} + \alpha 2\, LDCONS_{t-1} + \alpha 3\, LREER_{t-1} + \alpha 4\, LSCA\_PRE_{t-1} \\ &+ \sum_{i=1}^{p} \alpha 5\, \Delta LRIMPT_{t-i} + \sum_{i=0}^{p} \alpha 6\, \Delta LDCONS_{t-i} + \sum_{i=0}^{p} \alpha 7\, \Delta LREER_{t-i} + \sum_{i=0}^{p} \alpha 8\, \Delta LSCA\_PRE_{t-i} \\ &+ \phi DUMMY + \varepsilon_t \text{ ---------- (18)}\end{aligned}$$

Where Δ denotes the first difference operator, p is the optimal lag length and ε_t is the error term The ARDL estimation strategy can be implemented in three phases, as shown in an empirical paper by Pesaran et al. (2001). First, the determination of a cointegrating relation among the variables is determined; second, the long-run is estimated; and finally, the estimation of the error correction model is undertaken.

Stage 1: equation (18) is estimated to ascertain the existence of a cointegrated relationship between real import demand and its determinants. The bounds testing approach to cointegration is utilized using an F or Wald test statistics on the null hypothesis of no cointegration between the variables, against the alternative hypothesis of the presence of cointegration. This is done by normalizing for LRIMPT and state the null hypothesis as:

$$H0 : \alpha 1 = \alpha 2 = \alpha 3 = \alpha 4 = 0$$

$$H1 : \alpha 1 \neq \alpha 2 \neq \alpha 3 \neq \alpha 4 \neq 0$$

Comparison of the calculated F-statistic with two sets of critical values computed by Pesaran, Shin, and Smith (2001) for a given level of significance in their bound testing approach to the analysis of the long-run relationship determines whether or not the null hypothesis should be rejected. The null hypothesis of no cointegration can be rejected if the F-statistic is greater than the upper bound critical values, which indicates that all variables are cointegrated. From this, we infer that the variables are linked over the long-term. Thus, we then move to stage 2.

Stage 2: At this point, we use the normalised restricted conditional ARDL long-run model to estimate the long-run parameters of Sierra Leone's aggregate import demand function, as detailed below:

$$LRIMPT_t = \alpha_0 + \sum_{i=1}^{p} \alpha_1 LRIMPT_{t-i} + \sum_{i=0}^{p} \alpha_2 LDCONS_{t-1} + \sum_{i=0}^{p} \alpha_3 LREER_{t-1} + \alpha_4 \sum_{i=0}^{p} LSCA\_PRE_{t-1} + \phi DUMMY + \varepsilon_t \quad (19)$$

Stage 3: We obtain the short-run dynamic parameters by estimating an error-correction model (ECM) .The short-run error correction model specified as:

$$\Delta LIMPT_t = \beta_0 + \lambda ect_{t-1} + \sum_{i=1}^{p} \alpha_5 \Delta LIMPT_{t-i} + \sum_{i=0}^{p} \alpha_6 \Delta LDCONS_{t-i} + \sum_{i=0}^{p} \alpha_7 \Delta LREER_{t-i} + \sum_{i=0}^{p} \alpha_8 \Delta LSCA\_PRE_{t-i} + \phi dummy + \varepsilon_t \quad (20)$$

Where $\alpha_5, \alpha_6, \alpha_7, \alpha_8$ are the short-run dynamic coefficients of the model's convergence to equilibrium, and λ is the rate at which the system returns to long-term equilibrium after a perturbation. It is anticipated that the error correction term will be negative and statistically significant. The ARDL model defined by equation (18) is then subjected to a battery of diagnostic tests, including tests for serial correlation, heteroscedasticity, normality, and model misspecification .In addition, the CUSUM (Cumulative Sum) and CUSUMQ (Cumulative Sum of Squares) tests were used to verify the stability of the model's parameters, guaranteeing the accuracy of policy simulations based on the model.

3.2 Data

This study's empirical analyses are based on annual time series data for the following variables from 1980 to 2020: imports of goods and services, domestic consumption, real effective exchange rate, consumer price index, and scarcity premium. Most studies on import demand use relative prices calculated as the ratio of import prices to domestic prices. However, because this variable is unavailable for Sierra Leone, we have used the real effective exchange rate as a proxy for relative prices. (RGDP + Real Imports - Real Exports)/Foreign Exchange Reserves is the scarcity premium. Data on imports and exports of goods and services, real GDP, and gross international reserves were obtained from the World Bank's World Development Indicator (WDI) 2020 database, while consumer price index was obtained from the International Monetary Fund's World Economic Outlook 2021 database. All of the variables are converted to natural logarithms. A trade liberalization dummy with a value of one for 1980-1986 and zero for 1987-2020 the post-liberalization period is also included.

4. Empirical Results

4.1 Descriptive Statistics

We analysed the dynamics of the variables before generating a formal estimate of the import demand function. The descriptive statistics are summarised in Table 1. The statistics indicates that domestic consumption recorded the highest average, while the scarcity premium registered the lowest average value. In addition, there is evidence of low volatility in the variables, as reflected in the low standard deviations. Except for the real effective exchange rate, all of the variables in the study follow a normal distribution. For real import, domestic consumption, and scarcity premium, we cannot reject the null hypothesis of normal distribution at the 1% significance level, but for real effective exchange rate, we can.

Table 1. Descriptive Statistics

	LRIMPT	LDCONS	LREER	LSCA_PRE
Mean	19.98161	27.35186	4.976659	3.504149
Median	19.77038	28.10012	4.814245	3.425316
Maximum	21.6434	31.40729	6.332724	6.171149
Minimum	18.84158	20.85919	4.514838	1.851222
Std. Dev.	0.975038	3.334964	0.482564	1.326507
Skewness	0.630381	-0.690881	1.576253	0.404868
Kurtosis	1.901029	2.228861	4.320918	1.872015
Jarque-Bera	4.778655	4.277531	19.95866	3.293708
Probability	0.091691	0.1178	0.000046	0.192655
Sum	819.2459	1121.426	204.043	143.6701
Sum Sq. Dev.	38.02798	444.8794	9.314716	70.38482
Observations	41	41	41	41

Authors' computation

4.2 Correlation Coefficient

The correlation matrix is shown in table 2. The matrix indicates a positive relationships between real import demand and domestic consumption. This relationship is consistent with the apriori expectation, given that Sierra Leone has high import propensity for both consumption and investment goods. It can also be inferred from the correlation matrix that both the real effective exchange rate and scarcity premium negatively impacts real import demand.

Table 2. Correlation Coefficient

	LRIMPT	LDCONS	LREER	LSCA_PRE
LRIMPT	1.0000	0.7356	-0.4158	-0.7997
LDCONS	0.7356	1.0000	-0.8304	-0.8757
LREER	-0.4158	-0.8304	1.0000	0.6042
LSCA_PRE	-0.7997	-0.8757	0.6042	1.0000

Authors' computation

4.3 Stationarity Test

Table3 displays the outcomes of the ADF and PP tests used to investigate the variables' stationarity properties. It shows that with the exception of the scarcity premium, all variables are not level-stationary. Since this is the case, the unit root hypothesis cannot be rejected from the data. This suggests the variables are not perfectly predictable, are subject to random fluctuations, and do not return to their long-term average after experiencing a shock. Both the Augmented Dickey-Fuller test (1979) and the Philips-Perron test (1988) showed that all variables became stable at first difference, indicating that they are integrated of order one or I (1).After confirming that the variables are I(1), we apply the bounds testing method to the ARDL model in order to look for evidence of cointegration.

Table 3. Unit Root Tests

	Augmented Dickey-Fuller (ADF)	Phillip Perron (PP)	Conclusion
	Level		
Variables	**Intercept and Trend**	**Intercept and Trend**	
LRGDP	-1.2467	-1.2588	Non stationary
LDCONS	-0.4430	-0.7186	Non stationary
LRIMPT	-2.7436	-2.7412	Non stationary
LREER	-1.5693	-1.8723	Non stationary
LSCA_PRE	-3.3581	-3.4519	Non stationary
	First Difference		
	Intercept and Trend	**Intercept and Trend**	
LRGDP	-5.9849*	-5.9849*	Stationary
LDCONS	-4.6422*	-4.6020*	Stationary
LRIMPT	-7.0490*	-7.0106*	Stationary
LREER	-4.9214*	-4.8600*	Stationary
LSCA_PRE	-7.1022*	-7.1587*	Stationary

Note: * indicate statistical significance at 5percent level, respectively. Authors' computation

4.4 Lag selection

One of the most important requirements for employing the ARDL estimation method is picking a suitable lag for the model. We calculated the ideal lag by using the sequentially modified LR test statistic, the Final prediction error, the Akaike information criterion, the Akaike information, the Schwarz information, and the Hannan-Quinn information criterion. Table 4 uses the Akaike information criteria to select the best possible Lag. We choose lag 1 as the

appropriate lag after the AIC because it solves the problem of autocorrelation and works great with limited data (Lu Tkepohl, 2006).

Table 4. Lag Length Selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-67.64305	NA	3.69e-05	3.981695	4.408249	4.134739
1	119.4052	306.9509*	9.25e-09*	-4.328469*	-2.835529*	-3.792815*
2	131.5224	16.77779	1.95e-08	-3.667818	-1.108492	-2.749554

Note:* indicates lag order selected by the criterion. LR: sequential modified, FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion. Authors' computation

4.6 ARDL Bounds Tests for Co-integration

The ARDL bounds test to cointegration presented in table 5 demonstrates that the F-statistics (6,3724) obtained by the model ARDL (1, 1, 1, 1) is more than the upper bound of 5,61 at a significance level of 1%, thereby rejecting the null hypothesis of no cointegration. Thus, we can conclude that a long-run equilibrium exists between the actual import of goods and services and its drivers, namely domestic consumption, the real effective exchange rate, and scarcity premium.

Table 5. Estimates of Bound Tests for Long-run Relationship

F-Bounds Test		**Null Hypothesis: No levels relationship**			**Conclusion**
Test Statistic	Value	Significance	I(0)	I(1)	
F-Statistics	6.3724	10percent	2.72	3.77	
K	3	5percent	3.23	4.35	Evidence of cointegration
		2.5percent	3.69	4.89	
		1percent	4.29	5.61	

Authors' computation

4.7 Long-Run Relationship of Import Demand Function

After validating the presence of a long-run cointegration relationship between real imports and their determinants, we estimated the long-run model parameters. The estimated long-run coefficient from the ARDL (1, 1, 1) model is shown in table 6. On the basis of the obtained coefficients, we therefore conclude that only domestic consumption has a statistically significant effect on long-term real imports of goods and services. Our findings is consistent with the result obtained by Rashid et al (2013) in their study for Pakistan. Real effective exchange rate and scarcity premium have the expected indications, but their impact on real imports of goods and services was statistically insignificant. An increase of 1 percent in domestic consumption results in an increase of 0.61 percent in actual imports of goods and services.

Table 6. Estimates of Long-Run Coefficients of Import Demand Determinants

Dependent Variable is LRIMPT				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LDCONS	0.6075	0.2395	2.5367	0.0164
LREER	-0.2967	0.9769	-0.3037	0.7634
LSCA_PRE	-0.1662	0.4750	-0.3500	0.7287

Authors' computation

4.8 Short Run Relationship of Import Demand Function

The short-run dynamics are provided by the error-correction representation of the ARDL (1, 1, 1, 1) model. The estimated values are shown in table 7. The negative statistical significance of the error correction factor provides additional empirical support for the presence of a cointegration relationship between actual imports and their drivers. ECT values of -0.23 show that roughly 23% of the short-run disequilibrium between these variables is rectified on an annual basis. The coefficient of determination (R-squared) indicates that the model's explanatory variables explain approximately 53% of the variance in actual imports of goods and services. Neither the DW nor the F statistics suggest autocorrelation, either. The estimated short-run model shows that the coefficients of domestic consumption, scarcity premium, and trade liberalization dummy are statistically significant, while the coefficient of the real effective exchange rate is not. In particular, domestic spending has a positive effect on real imports of goods and services, with a 1% rise in domestic consumption resulting in a 0.94 % increase in real imports of goods and services. This result corroborate the findings from Rashid et al (2013) and Omotor (2010). The premium for foreign exchange scarcity (the foreign exchange restriction variable) was statistically significant at the 5% level, but with the wrong sign. This suggests that a 1% increase in scarcity premium would result in a 0.16 per cent increase in real imports. This result contradicts the result in the study by Rashid et al (2013) who found the scarcity premium to be negative and statistically significant for Pakistan.

The positive sign for scarcity premium in the case of Sierra Leone could be partly explained by Central Bank's intervention efforts over the years, which supplied the private sector with foreign currency to facilitate the importation of essential products despite foreign exchange restrictions. The second potential factor is the importation of machinery and transport equipment by the mining sector during their mobilization phase, which is financed mostly by external sources. The trade liberalization dummy was also statistically significant at the 1% significance level. According to the data, a 1% rise in trade liberalization will raise the real import of goods and services by 0.69 %.

Table 7. Estimates of Short Run Relationship of Import Demand Determinants

	Dependent Variable DLIMPT			
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	0.9458	0.1840	5.1410	0.0000
D(LDCONS)	0.9329	0.2066	4.5145	0.0001
D(LREER)	0.1021	0.1993	0.5123	0.6121
D(LSCA_PRE)	0.1626	0.0777	2.0932	0.0446
DUMMY	0.6903	0.1900	3.6334	0.0010
ECM(-1)	-0.2271	0.0429	-5.2874	0.0000
R-squared	0.526551	Mean dependent var		0.045939
Adjusted R-squared	0.456927	S.D. dependent var		0.256101
S.E. of regression	0.18873	Akaike info criterion		-0.35952
Sum squared resid	1.211042	Schwarz criterion		-0.10619
Log likelihood	13.19042	Hannan-Quinn criter.		-0.26792
F-statistic	7.562701	Durbin-Watson stat		2.45221
Prob(F-statistic)	0.000073			

Authors' computation

4.9 Diagnostic Tests

This estimated model was put to the test with a battery of diagnostic procedures. Table 9 shows that the estimated model has no heteroscedasticity, normality, or serial correlation issues. The model's validity is further verified by the Ramsey functional form test which confirmed that the model is well specified.

Table 9. Diagnostic tests

Test	**Heteroscedasticity**	**Normality**	**Serial correlation**	**Functional form**
Test-statistics	1.4799	1.2534	2.2092	0.2969
p-value	0.2047	0.5344	0.1476	0.5899

Authors' computation using Eviews 10

4.10 Stability of the Estimated Parameters

Following a battery of diagnostic tests, we utilized the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) tests to assess the stability of long-run and short-run parameters. Figures 4 and 5 display the CUSUM and CUSUMSQ test results, respectively. It is evident from figures 4 and 5 that the model parameters are stable, as the CUSUM and CUSUMSQ plots fall well inside the critical limits (at 5percent significance level).We can therefore conclude that the estimated coefficients are stable and the estimated models are robust and reliable.

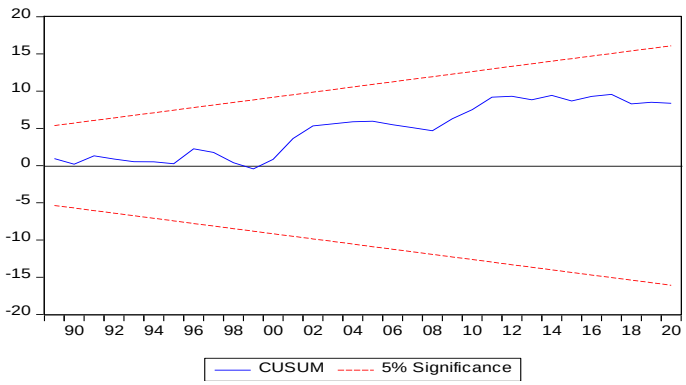

Figure 4. The cumulative sum

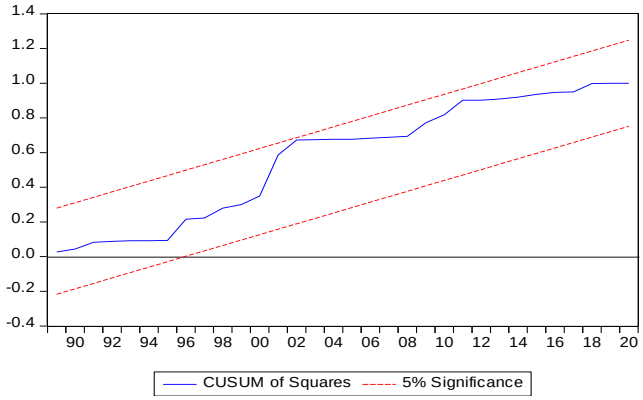

Figure 5. The cumulative sum of squares

5. Conclusion

This study's primary purpose is to model the aggregate import demand function for Sierra Leone, taking into account both theoretical and empirical concerns related to the estimation of import demand functions, especially for developing nations. Specifically, we applied the structural model from Emran and Shilpi (2010) that includes a binding foreign exchange restriction to estimate an import demand function for Sierra Leone using time series data from 1980 to 2020. We estimated the real import demand model for Sierra Leone using ARDL bounds testing to incorporate both short-term and long-term linkages. The empirical findings indicate that real import demand and its determinants are long-run cointegrated.

After validating the presence of a long-run cointegration relationship between real imports and their determinants, we estimated the long-run model parameters. Except for domestic consumption, all other variables, including real effective exchange rate and scarcity premium, have the correct signs but were statistically insignificant in affecting real imports of goods and services over the long term. In the long run, domestic consumption has a statistically significant impact on real imports of goods and services, with a 1 per cent rise in domestic consumption resulting in a 0.61 per cent increase in real imports of goods and services. In the short-run, however, domestic consumption, scarcity premium, and trade liberalization dummy were found to be statistically significant in explaining real import demand in Sierra Leone, excluding the real effective exchange rate. The result of 0.23 with a negative sign indicates the convergence of the model of import demand to long-run equilibrium. Notably, the foreign exchange scarcity premium (the foreign exchange restriction variable) was shown to be statistically significant at the 5% level, albeit with the incorrect sign. This indicates that a 1% increase in scarcity premium would result in a 0.16 % increase in real imports of goods and services. This trend could be traced in part to the Central Bank's intervention policies over the years, which supported the private sector with foreign exchange to ease the importation of vital goods in the face of foreign exchange constraints. Finally, diagnostics and stability tests were conducted to validate the robustness of the Sierra Leone import demand model. The model passed all diagnostic tests and was deemed stable because the plots of the CUSUM and CUSUMSQ statistics were well within the threshold limits of 5 per cent. The analysis reveals that the import demand in Sierra Leone is not hindered by a shortage of foreign currency.

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