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An Econometric Estimation of Import Demand Function for Cote D'Ivoire

N'guessan Bi Zambe Serge Constant (Corresponding author)
School of International Business Administration, Shanghai University of Finance and Economics
369 Zhong Shan Bei Yi Road, Shanghai, China
E-mail: djinan5@yahoo.fr
Yaoxing Yue
School of International Business Administration, Shanghai University of Finance and Economics
777 Guoding Road, Shanghai 200433, China
E-mail: yxyue777@yahoo.com.cn

Abstract

This paper examines a disaggregated import demand model for Cote d'Ivoire using time series data for the period 1970-2007. An Autoregressive Distributed Lag (ARDL) modeling process is employed to capture the effect of final consumption expenditure, the investment expenditure, the export expenditure and relative prices on import demand. Amongst the key results it is found that a long run cointegration relationship between the variables; and shows inelastic import demand for all the expenditure components and relatives prices. In the long run, investment and exports are the main determinant in Cote d'Ivoire imports. However in the short run both of the components of expenditures are the major determinants of Import demand. Import demand is not sensitive to price changes.

Keywords: ARDL cointegration, Cote d'Ivoire, Import demand

1. Introduction

In the recent years, because of the popularity of the globalization, the interdependence among countries at world level has increased. Every country wants to achieve rapid pace of economic development trough getting the maximum benefits from international trade and the use of the modern techniques in the productions process. With the implementation of the world trade organization (WTO) rules and substantial reduction in trade restrictions most of the developing countries imports' are increasing rapidly. Cote d'Ivoire's economy is not an exception as it depends on the of the world's economic trends.

Cote d'Ivoire is a low-income country with a per capita income of 769.8 Euros (2008) and 20.8 million population of inhabitants (DG TRADE, 2009).The country ranked 166 out of the 177 in the 2008 United Nations Human Development Index (UNHDI). About 14.8 per cent of the Cote d'Ivoire population has been estimated to live below the poverty line of 1 US$ /day over the period of 1990-2005.Nearly 48.8 per cent of the population lives below $2(HDI report, 2008).

Cote d'Ivoire is the largest producer and exporter of cacao beans and a significant producer and exporter of coffee and palm oil. The agricultural sector employs over 68 per cent of the population. With the recent statistics the agricultural sector account now for 23.4 per cent, the industry sector 26.1 per cent and the services sector 50.5 per cent (respectively in per cent of the GDP) due to the new orientations of government in the diversification of the economy. However, the political-military crisis since 1999, along with the civil war and division of the country since 2002, has plunged the country into severe economic troubles. It must be stressed that the economy has not collapsed, despite disruptions in infrastructure and the business environment. But several formerly important sectors are deeply damaged, corruption is growing, and modest macroeconomic growth only comes from the cocoa-growing areas of the country and the oil exploration in the Gulf of Guinea, which have been largely untouched by the conflict. Employment has gone down in both parts of the country and outstanding debts have grown. The government, meanwhile, aims to attract the foreign investment to boost the economic growth.

In Cote d'Ivoire, imports as a share of GDP has been rising over than the last decade. A significant share –around 46.29 per cent- of Cote d'Ivoire's national income was spent on import payments in 2008(WDI, 2008).Given that effectiveness of any country's international trade policy in relation to its balance of payments and development depends on the magnitude of the income and price elasticities of its exports and imports, the central aim of this paper is to estimate the determinants of Cote d'Ivoire's demand import by using annual data for the period 1970-2007.Following recent studies(Ho 2004; Nayaran and Nayaran,2005) we used the disaggregated components of domestic income together with the standard relative price variable to specify the aggregate import demand model for Cote d'Ivoire. For policy purposes, it is relevant to know the determinants of aggregate import in Cote d'Ivoire. Among the literature we surveyed, this paper is the first to use the recent disaggregated import demand formulation approach and the autoregressive distributed lag (ARDL estimate to study the aggregate import demand in Cote d'Ivoire.

As the thrust of this paper is to estimate the aggregate import demand for Cote d'Ivoire by using annual data for the period 1970-2007, the paper is organized as follows: Section 2 discusses the literature review about the aggregate import demand. The model specifications and the econometric methodology used are indicated in Section 3 while the empirical results of the study are presented in section 4; section 5 emphasizes the conclusion of the paper.

2. Literature Review

In view of the importance of foreign trade to economic growth and development, a number of empirical studies on the import demand functions have been carried out. The objective here is to review some of these studies as a guide to the choice of appropriate variables used in this study.

Tang and Nair (2002) evaluate the stability of the import demand function in Malaysia using the bounds test. Import demand, income, and relative price are found to be cointegrated. Their study derives long-run income and relative price elasticities of 1.5 per cent and -1.3 per cent, respectively. Bahamani and Kara (2003) estimated the import and export demand function for nine industrial countries like Australia, Canada, Denmark, US and etc. By using quarterly data for the period 1973-98 they used ARDL approach for estimation. Their results show that long-run income elasticities are greater in import demand function than in the export demand functions are relatively inelastic .They fail to provide any specific answer to the policy question that which policy has the quickest impact on trade. According to them, trade flows of different countries do react differently.

Ho (2004) estimated the import demand function of Macao by testing two popular models: (i) aggregate and (ii) disaggregate import demand model with the components of aggregate expenditure using quarterly data over the 1970-1986 period. Using JJ-Maximum likelihood cointegration and error correction technique, he found significant partial elasticities of import demand with respect to investment(0.1396),exports(1.4810) and relative prices (-0.3041) with their expected signs implied by the economic theory in the disaggregated model. Narayan and Nayaran (2005) recently applied the bounds testing approach to cointegration to estimate the long-run disaggregated import demand model for Fiji using relative prices, total consumption, investment expenditure, and export expenditure variables over the period 1970-2000.Their results indicated a long-run cointegration relationship among the variables when import demand is the independent variable; and import demand to be elastic and statistically significant at the 1 per cent level with respect to all the explanatory variables in the long-run and short-run. The results revealed that long-run elasticities of 0.69 for both export expenditure and total consumption expenditure respectively, followed by relative prices (0.38) and investment expenditure.

From the empirical literature we surveyed, the import demand function generally focuses on developed countries. A few studies were conducted on developing countries particularly in the continent of Africa. Arize (1987) estimates elasticities in the import demand function in Nigeria from 1960 to 1977 using the Cochrane–Orcutt and two-stage least-squares methods. Income elasticity of import demand is high, as is to be expected in an oil exporting country. The study inspects the structural stability of the estimated function according to the Brown–Durbin–Evans test. A structural change is found in 1971, and the result is confirmed by the Chow test. Indeed, an influential import substitution policy was implemented in Nigeria from 1971 to 1972.

Mwega (1993) investigates the short-run dynamic import function in Kenya using an error correction model. Import demand exhibits low elasticities with respect to relative price and income. Stabilization and exchange rate policies would not bring about rapid amelioration of the external disequilibrium, and foreign exchange reserves appear to be the main determinant of imports. The Chow test reveals the stability of the function .Gumede (2000) examines aggregated and disaggregated import demand for South Africa in a framework of cointegration analysis. They obtain the long-run relationship among the variables from the two-step Engle–Granger technique and introduce it into a short-run dynamic model. Income elasticity is found to be much larger than price elasticity. Ivohasina and Hamori (2005) analyzed the long-run relationship among the variables in the aggregate import demand functions of Madagascar and Mauritius in the order to evaluate the appropriateness and effectiveness of the structural adjustment program (SAPs).They used the UECM-based bounds test to investigate cointegration. They found the existence of cointegration relationship between the variables. The long-run income and price elasticities are respectively, 0.855 and -0.487 for Madagascar and 0.671 and -0.644 for Mauritius. They found that the stabilization and devaluation policies under the SAPs can be effective in the reducing import demand. They also estimated Export demand functions. The LM-test is fully met for Mauritius but unequivocal inference cannot be drawn for Madagascar .While both countries achieved lower external deficits, their economies have shown dissimilar growth performance, with remarkable expansion in Mauritius versus mitigated growth in Madagascar .Hence, the ultimate policy objective should not be confined in containing imports, but should seek to simultaneously improve external balance and economic growth.

3. The Model Specifications and Methodology

In modeling an aggregate import demand function for Cote d'Ivoire, we follow the imperfection substitutes model, in which the key assumption is that neither imports nor exports are perfect substitutes for the domestic goods of the countries under consideration (Goldstein and Khan, 1985). Since Cote d'Ivoire imports only a relatively small fraction of total world imports, it may be quite realistic to assume that the world supply of imports to Cote d'Ivoire is perfectly elastic. This assumption of infinite import supply elasticity reduces our model to a single equation model of an import demand function.

The present analysis follows the used specifications of the aggregate import demand function formulations by Tang (2003), Nayaran and Nayaran (2005).We divide domestic income into its final demand expenditure components (i.e. $Y_t = C + I + X$) and specify a computable disaggregate import demand model for Cote d'Ivoire as follows:

$$lnM_t = \alpha_0 + \beta_1 lnFCE_t + \beta_2 ln\,EIG_t + \beta_3 lnX_t + \gamma lnRP_t + \alpha_1 Dum_t + \vartheta_t \quad (1)$$

Where lnM_t is the natural log of real imports of goods and service, $lnFCE_t$ is the natural log of real of the final consumption expenditure, $lnEIG_t$ is the natural log of real expenditures on investment goods (i.e. sum of gross capital formation and change in inventory); and lnX_t is the natural log of real exports, $lnRP_t$ is the natural log of the relative prices(ratio of import price index to domestic price index), Dum_t is the time dummy which captures structural change due to trade liberalization. It is important to know that it was in 1986 during the wave of independence the Cote d'Ivoire government first adopted a liberalization policy, but the effectiveness of liberalization seems to have begun in 1995. Thus the dummy variable takes the values 0 for 1970-1994 and 1 for 1995-2007.And ϑ_t is the *i.i.d* error term at period *t* .Since data for import price index is not available we used the import unit value to proxy import price index for Cote d'Ivoire. All data are in billions of F.cfa (local currency).

The above specifications represent only the long-run equilibrium state of import demand. However, for policy reasons, the short-run adjustment of imports to changes in its determinants is necessary. To capture the speed of adjustment we estimate the following dynamic error correction model:

$$\Delta lnM_t = \beta_0 + \sum_{i=1}^{n} \beta_1 \Delta lnM_{t-i} + \sum_{i=0}^{n} \beta_2 \Delta lnFCE_{t-i} + \sum_{i=0}^{n} \beta_3 \Delta lnEGI_{t-i}$$

$$+ \sum_{i=0}^{n} \beta_4 \Delta lnX_{t-i} + \sum_{i=0}^{n} \gamma \Delta lnRP_{t-i} + \psi ECM_{t-i} + \alpha D_t + \varepsilon_t \quad (2)$$

Where, Δ represents first difference operator and ECM_{t-i} is the one period lagged error correction term estimated from equation (1). ψ measure the speeds of adjustment to obtain equilibrium in the event of shocks to the system. All annual data were drawn from the World Bank's *World Development Indicators* CD-ROM and from the International Monetary Fund's *International Financial Statistics* CD-ROM .In this study the period of estimation run from 1970 to 2007.

The ARDL bounds test approach developed by Pesaran *et al.* (2001) is used to estimate Equation (1).The choice of this methodology is based on several considerations. Firstly, the ARDL methodology circumvents the problem of the order of integration associated with the Johansen likelihood approach. Secondly, unlike most of the conventional multivariate cointegration procedures, which are valid for large sample size, the bound test is suitable for small sample size study (Pesaran, *et al*., 2001).Thirdly, this technique generally provides unbiased estimates of the long-run model and valid t-statistics even when some of the regressors are endogenous (Harris and Sollis,2003).Inder(1993) and Pesaran and Pesaran (1997) have shown that the inclusion of the dynamics may help correct the endogeneity bias. Hence, to apply the bounds procedure, the following autoregressive distributed lag (ARDL) model will be estimated in order to test the cointegration relationship between import demand, relative price and the expenditure component variables:

$$\Delta lnM_t = \alpha_0 + \eta_1 lnM_{t-1} + \eta_2 lnFCE_{t-1} + \eta_3 lnEGI_{t-1} + \eta_4 lnX_{t-1} + \eta_5 lnRP_{t-1}$$

$$+\sum_{i=1}^{p}\varpi_i \Delta lnM_{t-i}+\sum_{j=0}^{p}\varphi_j \Delta lnFCE_{t-j}+\sum_{k}^{p}\phi_k \Delta\, lnEGI_{t-k}$$
$$+\sum_{m=1}^{p}\tau_m \Delta lnRP_{t-m}+\alpha_1 D_1+\varepsilon_t \qquad (3)$$

The first step in the ARDL approach is to estimate Equation (3) using the ordinary least square (OLS).The second step is to trace the presence of cointegration by restricting all estimated coefficients of lagged level variables equal to zero. That is, the null hypothesis of no cointegration (*Ho*: $\eta_1=\eta_2=\eta_3=\eta_4=\eta_5=0$) is tested against the alternative (*H$_1$*:$\eta_1 \neq \eta_2 \neq \eta_3 \neq \eta_4 \neq \eta_5 \neq 0$) by the mean of a F-test with an asymptotic non standard distribution. Two asymptotic critical value bounds provides a test for cointegration when the independent variables are *I* (*d*) with 0≤ d≤1.The lower bound assumes that all the regressors are *I*(0),and the upper bound assumes that they are *I*(1).If the computed F-statistic lies above the upper level band , the null is rejected, indicating cointegration. If the computed F-statistic lies below the lower level band, the null cannot be rejected, supporting the absences of cointegration. If the statistics fall within the band, inference would be inconclusive. After confirmation of the existence of the long-run relationship between the variables in the model, the long-run and short-run models can be derived using information criteria such as the Schwartz Bayesian or the Akaike information criteria.

To ascertain the goodness of the fit of the ARDL model, the diagnostic and stability tests are conducted. The diagnostic test examines the serial correlation, functional form, normality and heteroscedasticity associated with the model. The stability test of the regression parameters is undertaken using the Brown et al. (1975) stability testing technique, also known as cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ).

4. Empirical Results

In order to perform the bounds testing procedure, we estimated equation (3) using the ARDL approach to cointegration. The bounds test for cointegration involves the comparison of the F-statistics against the critical values. Each variable in our model for equation (1) is taken as a dependent variable in the calculation of the F-statistic .The calculated F-statistics are reported in table 2.According to the computed F-statistics; we can reject the null hypothesis of no cointegration at 1 percent significance level for import demand. The computed F-statistic $F_M(M/FCE, EGI, X, RP)$= 6.7031 is higher than the upper bound critical value of 5.763 at the 1 per cent significance level. Also both $F_{FCE}(FCE/M, EGI, X, RP)=5.5863$ and $F_{RP}(RP/M, FCE, EGI, X)=8.6620$ were higher than the upper bound critical value of 5.763 at the 1 per cent level. However, based on the model specifications above, we used M_t as the dependent variable.

Having found a long run relationship between import demand and its determinants when import demand is the dependent variables, we now estimate the long-run elasticities based on the following ARDL (*m, n, o, p, q*) specifications:

$$lnM_t=\beta_0+\sum_{i=1}^{m}\beta_1\, lnM_{t-i}+\sum_{i=0}^{n}\beta_2\, lnFCE_{t-i}+\sum_{i=0}^{o}\beta_3\, lnEGI_{t-i}+\sum_{i=0}^{p}\beta_4\, lnX_{t-i}+\sum_{i=0}^{q}\beta_5\, lnRP_{t-i}+\alpha_1$$
$$+\vartheta_t \qquad (4)$$

Where, all variables are as previously defined. The lengths of the lags in the ARDL model was used based on the Akaike Information Criterion before the long-run elasticities were estimated using the ARDL approach. For our annual data, Pesaran and Shin (1999) suggest a maximum of 2 lags.

The long-run results are presented in table 2. All the estimated variables have their expected signs. Our results show that for Cote d'Ivoire import demand function using the disaggregate form the imports are mainly determined by the consumption activities and by the export. For instance, our results reveal that a 1 per cent increase in consumption expenditure and export expenditure induce an increase in imports by 0.65 per cent and 0.49 per cent respectively. Meanwhile, we find that a 1 per cent increase in investment expenditure leads to a 0.10 per cent increase in imports. This is due mainly by the recent series of socio- politico-military troubles during the period 1999 to 2002.This period of troubles with its degree of instability contributed to slowdown the economy performance through the fall of attracting the investment. As can be emphases, over the 1999-2002 periods, the private investments in Cote d'Ivoire has a average of 9.4 per cent of the real GDP (World Development Indicators and authors calculations, 2008). Thus, in the recent years one of the central aims of Cote d'Ivoire government has been put in the development of private investment to help boost economic growth and reduce poverty. With respect to the relative price variable, a 1 per cent increase in the relative price will contribute to a very low import bill of Cote d'Ivoire (0.05 per cent).

The various measures of impact of disaggregate import demand are therefore very relevant. The dummy variable for trade liberalization carries out the expected sign but with a low magnitude. All estimates are inelastic. Table 3 reports the results of the short-run elasticities. The error correction term, ECM_{t-1}which represents the speed of adjustment, is positive and not significant. ECM_{t-1} , measure the speed at which import demand adjust to changes in the explanatory variables before converging to its equilibrium level. The coefficient of 0.0035 suggests that convergence to equilibrium after a shock to imports is very slow in Cote d'Ivoire.

We find that as in the long-run, the short-run impact of various expenditure components is inelastic. A 1 per cent increase in consumption expenditure will lead to 0.96 per cent in imports and also a 1 per cent increase in expenditure on export induces 0.51 per cent in imports. The impact of the expenditure on investment in the short-run is as in the long-run have is relatively small; a 1 per cent increase induces 0.12 per cent in imports. In this period both expenditures on consumption, investment and export are statistically significant at the 1 per cent level. The relative prices variable is negatively related with imports (-0.23).

In the regression analysis, the stability of coefficients is considered to be essential for policy purposes. Therefore, the stability tests are performed. The stability of import demand function is very important for the effectiveness of trade policy. In stability test, we see whether the estimated import demand function has shifted or not over the time period included in the sample of the study. We have applied CUSMUS and CUSMUS of Square (Brown, Durbin and Evans, 1975) Tests and Recursive coefficients to check the stability of the import demand function. The model appears stable and correctly specified given that neither the CUSMUS nor the CUSMUS of Squares test statistics exceed the bounds of the 5 per cent level of significances(see Figures 1 and 2).

5. Conclusion

Following Tang (2003), Narayan and Narayan (2005) the import demand function for Cote d'Ivoire is estimated. By employing the recently developed cointegration technique the bounds testing approach to test the long-run relationship between imports, relative import prices, final consumption expenditure, investment expenditure and export expenditure using annual data for the period 1970-2007.We find evidence of a cointegration relationship among the variables in the import demand function when import demand, final consumption expenditure and relative prices are the dependent variable. However based on the model specifications we used import demand as dependent variable. This allows us to examine the long run elasticities but also the short run of Cote d'Ivoire import demand for policy implications. We find that an inelastic and positive relationship exist between the final consumption expenditure, the expenditure on investment and goods and the expenditure on exports. Relative price is also inelastic but negatively impact aggregate demand implying that the import demand is insensitive to increase in domestic levels. Thus the Cote d'Ivoire policymakers have to deal closely with the competitiveness of the relative prices to boost growth and development of the local industries.

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Table 1. Critical value bounds of the statistic: intercept and no trend

	90 per cent level		95 per cent level		99 per cent level	
k	*I*(0)	*I*(1)	*I*(0)	*I*(1)	*I*(0)	*I*(1)
4	2.525	3.560	3.058	4.223	4.280	5.840
Calculated F-statistic						
F_M (M/FCE, EGI, X, RP	6.7031					
F_{FCE} (FCE/M, EGI, X, RP)	5.5863					
F_{EGI} (EGI/M, FCE, X, RP)	1.8048					
F_X (X/M, FCE, EGI, RP)	4.8527					
F_{RP} (RP/M, FCE, EGI, X)	8.6620					

Notes: critical values are extracted from Narayan (2004a, b, 2005a) *k* is the number of regressors.

Table 2. Estimated Long Run elasticities of import demand using the ARDL approach

Dependent variable: lnM_t Explanatory variables	Coefficient	*t*-statistic
Constant	-16.8263	-2.3957
$lnFCE_t$	0.6550	2.1905
$lnEGI_t$	0.0971*	2.7020
lnX_t	0.4926*	4.1567
$lnRP_t$	0.1955	-1.1327
Dummy	0.0484	1.1527

Note:*denotes statistical significance at the 1 per cent level

Table 3. Estimated Short Run elasticities of import demand using the ARDL approach

Dependent variable: ΔlnM_t Explanatory variables	Coefficient	*t*-statistic
Constant	0.9949	0.4468
$ln\Delta FCE_t$	0.9587*	4.0262
$ln\Delta EGI_t$	0.1166*	3.7375
$ln\Delta X_t$	0.5146*	3.9897
$ln\Delta RP_t$	-0.2392	-1.3582
Dummy	0.0569	1.0604
ECM_{t-1}	0.0034	0.4556

Note:*denotes statistical significance at the 1 per cent level

Table 4. Diagnostics tests

ARCH test (2)	F-statistic: 0.7220(0.4940)	R^2 : 0.9161
White test	F-statistic: 1.0591(0.5201)	$\bar{R}^2$:0.7364
Jarque-Bera	1.0023(0.6058)	F-statistic: 5.0974(0.01845)
Ramsey Reset	F-statistic: 0.4153(0.6666)	
Chow test (1997-2007)	F-statistic: 0.6210(0.7765)	

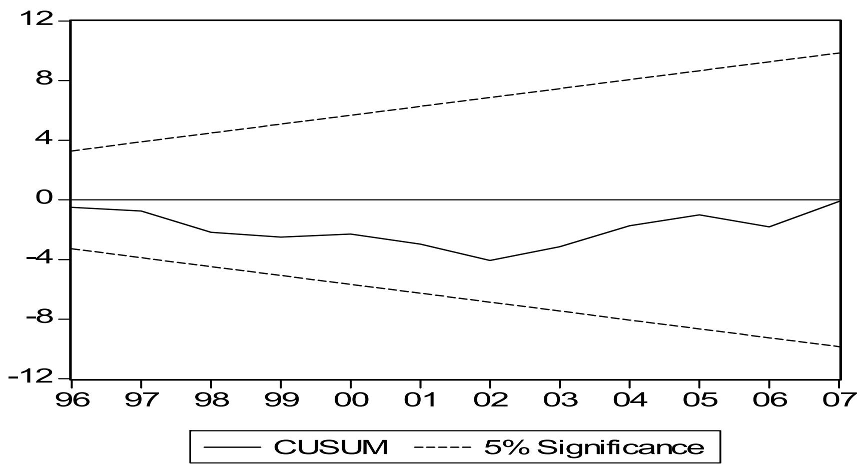

Figure 1. Plot of Cumulative Sum of recursive Residuals

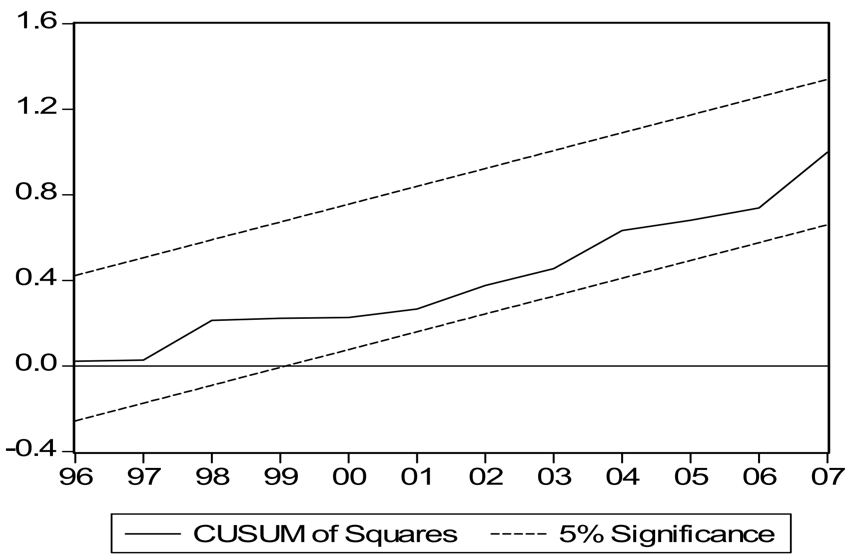

Figure 2. Plot of Cumulative Sum of Squares of Recursive Residuals