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Abstract

The paper examines the relationship between import demand and a set of foreign exchange supply channel (FESC) variables using annual time series data for Guyana over the period of forty years. Using single equations and vector autoregression (VAR) frameworks coefficients are estimated to establish both, the short- and long-run relationships between import demand, gross national income, and channel variables. The channel variables are defined as a convenient set of explanatory external-linkage variables, inclusive of official foreign aid (ODA), exports/import (XCM), exchange rate (XR), and foreign exchange reserves (FER). The findings contain a long-run relationship between import demand and the channel variables in all methodologies used. Thus the modeling of import demand using the FESC variables is supported. The implications for policy are that fiscal and monetary discipline must maintain efficient exchange rate and promote exports so that favorable foreign exchange reserves are present.

Keywords: long-run, cointegration, import demand, foreign exchange regeneration, supply channels.
JEL Classification: O19, C13, C51, F17.

Introduction

The demand for imports is determined by both economic and non-economic factors. In this paper we argue that the availability, size, growth and stability of a country's critical imports are a function of foreign exchange availability. This in turn depends on supply of foreign exchange generated by efforts of official institutions (domestic and international). These are involved in the transformation, growth and development of countries. The econometric evidence supplied in this paper supports this argument.

Standard specifications of import demand functions are based on a simple linear model in which imports compete with domestic absorption capabilities in reaction to growth in income, relative prices, exchange rate and behavior of exports (see, for example, Armington, 1969; Goldstein and Khan, 1985; Rose, 1991; and Hooper and Marquez, 1995). In this model, it is normal for the demand for imports to be thought of as the result of representative households (firms) maximization of utility (profits) which depends on the consumption (production) of domestic (imported) goods subject to a foreign exchange constraint. As such import stability could be achieved by balance of trade mechanisms brought about by exchange rate adjustments.

However, we go beyond this favored argument to argue that imports are sustained in developing countries by (1) the adequacy of available foreign exchange (cash at hand) and (2) the credit offered by suppliers based on calculation of risk and goodwill towards the importers (developing countries). The size of the first concern, represented by actual, estimated and committed amounts, relates to macroeconomic performance and political economy concerns that drive international trade. The second, driven by levels of confidence in the first, relates to where the importer (country) stands on the continuum of "nowill to goodwill" in international markets. It is useful therefore to consider that the level of import demand in a developing country must be determined by the availability of foreign exchange and access to credit at suppliers' and related government agencies.

This role of government agencies, bilateral or multilateral are of importance to this study. We draw on the related governments' concerns about the adequacy of foreign exchange in a developing country. These concerns focused on identifying factors that affect (positively or negatively) the diversity and availability of foreign exchange to pay for imports. UNCTAD based its concerns on the realization that nearly seventy percent of all imports are driven by the procurement needs of intermediate inputs, manufactured products, components, and new materials. The United Nations Conference on Trade and Development (UNCTAD) both at its UNCTAD 1964 and again at UNCTAD 2002 conference received pledges from developed countries to provide foreign exchange to developing countries in form of development assistance (Aydin et al., 2004). We call this consciousness "the provision of channels for the supply of foreign exchange", and more precisely "foreign exchange supply channels (FESC hereafter)".

This is a radical departure from the current literature on the estimation of import demand functions in a developing country. In fact, it points to a failing to estimate demand for import functions that are modeled without controlling for policy variables except exchange rate manipulation to fulfill macroeconomic objectives. For adequacy the policy variables should encompass the five major domains of inter-

national business and marketing, namely socio-cultural, legal, economic, political and technological and the interaction amongst them in the affairs of the global market place.

Putting this background into perspective, we undertake an estimation of an import demand function based on a clear definition of foreign exchange, its sources and delivery, and the impact of the various contributions on import demand in Guyana over the period for forty years. For this we define foreign exchange as: any direct and/or indirect external contributions of money, goods or services to growth and welfare development of a country. We identify the sources as "FESC". These are conduits through which the aggregate economic agents (domestic and foreign as well as international institutions) provide foreign exchange (money, kind, or service). Foreign exchange may be provided in consideration of normal business exchange or aid for humanitarian, growth and development purposes. These considerations are required to modify the conventional foreign exchange generative processes in developing countries that gather foreign exchange (exports, portfolio and foreign direct investments) to include development aid.

The inclusion of aid permits us to identify with the role of the developed countries in the affair of the import performance in developing countries. As such the flow of imports (its nature, volume, value, relevance and adequacy) into developing countries for transformation, growth and development purposes attracted the interests of academics as well as policy-making institutions.

The attendant empirical works in assessing these interests have been mainly with the determination of drivers as well as bottlenecks affecting the flow. Indeed, we argue that the decision of developed countries to intervene in trade affairs of developing countries rests with the recognition, acceptance, and belief that they can mitigate the disparities in economic development between developed and developing countries. Clearly, differences in levels of development between trading partners suggest a warranted need for official/government intervention. Heterodox economics support the intervention to counteract the shortcomings of market forces as observed in the performance of exports to finance imports of basic needs (consumption, raw materials, and intermediate goods), investment (capital) for growth and development (education, health, technology).

Research has shown that the size and nature of government intervention and participation in production and marketing activities may act as determinants of growth and development in primary commodity producers. Thus the FESC concept is cardinal to understanding the import demand in developing countries. It serves to indentify the influence of flows of value from one country on the production and consumption activities in another. In short it represents other dimensions of international finance influencing import demand not captured in the simplistic approach of domestic income, exchange rate and price as the main variables in traditional modeling of import demand.

The main objective of this study is to estimate an import demand function in a developing country that controls, through policy, the access, accumulation and retention of foreign exchange. We capture the three aspects in a model that augment the traditional import demand function (import-income-price-exchange rate nexus) with foreign exchange contributions from international agencies or emanating from macro policy decisions of "domestic global linkage agencies". This study has four important contributions to our understanding of import demand functions. First, it introduces the concept of "FESC" as plausible elements in generation of foreign exchange. Second, it offers an improved import demand function. Third it is the first to provide an estimate of an import demand function for Guyana that controlled for foreign exchange supply channel variables. Finally, the understanding of import demand in the literature will be broadened by considerations that emphasize political, social, cultural, historical, structural and institutional factors that interplay with economic factors to determine access, accumulation and retention of foreign exchange. These are exemplified by the institutional concept of both domestic and international official institutions.

To continue our analysis, we pursue identifying the extent to which foreign exchange, initiated by and flowing through the supply channels, impacts import demand in Guyana. Given the chosen variables to represent the FESC we expect that policy decisions made in anticipation of and in response to changes to the domestic and global linkages and targeted to influence Guyana's transformation, growth and development will impact the behavior of import demand in both the short and long-run. Given the predilection for balancing of international trade accounts as a constraint on growth and development, the traditional approach of income, prices and exchange rate as determinants in typical multiplier, absorption, or elasticity models may be inadequate (specification). Thus, we seek to control for other explanatory variables related to FESC, as the result of government and

international agencies activities. The variables include official development assistance (ODA), foreign exchange reserve (FER), and share-of-aid in capital formation (SACF). This approach is developed from the proposition that increases in the flow of foreign exchange, no matter what the source is, would enhance the flow of imports into Guyana and broaden our understanding of determinants of imports in a small open economy that face foreign exchange regeneration problems on the basis of weak competitive position in the global market.

Though there is vast literature available on the concerns for import demand, there is paucity of its application to Guyana. Thus, the choice of Guyana is an appropriate and credible case for studying the impact of the FESC variables. It is based, in addition to being a developing country with remnants of colonialism, on (1) its experiences with severe foreign exchange degradation, and (2) exposure to frequent economic crises. The history of Guyana's market and political economy, respectively, is mirrored with production and productivity erosion, unstable financial and political climate, and poor governance. We take the position that to identify the determinants of import demand in the presence of the FESC variables is to manifest the nature of the offset (positive or negative) of global policy influences to counteract domestic inadequacies in consumption, investment and foreign exchange supply. Indeed the "Washington Consensus" – promoted market economic precepts and privatizing of economies. As a result, Guyana experienced income growth in the very late 1980s and early 1990s like other developing countries based on an inflow of foreign exchange provided, including standby arrangements by international institutions – IMF and World Bank. The acceptance of the concept of privatization led to the beginning of debt forgiveness program through the Paris Club, bilateral and multilateral agencies (Modeste and Butts, 2003). Thus viewing improvement in the real and financial sectors, and sustainability of growth in Guyana we propose augmenting the traditional model of import demand with the contribution of the FESC – FER, ODA, and SACF.

Further, while many studies ignored methodological problems with the use of non-stationary data and the attendant spurious correlation issues, for this study we utilize cointegration and error-correction methodologies, which are known to overcome related concerns. Engle and Granger (1987) have established a method to determine a long-run equilibrium relationship amongst time series data. The method known as "EG" is considered to be a simple two step process. However, although it is simple, several short comings have been pointed out about its adequacy to treat complex relationships in multivariate models. The major criticisms include (1) it is designed to find only the dominant cointegrating vector rather than all possible cointegrating vectors; and (2) there is limited information available about asymptotic distribution of the EG test. These shortcomings are overcome with a subsequent method developed by Johansen-Juselius (1990), the maximum likelihood method to investigate cointegration among variables. The latter is considered superior to the EG test especially since it is robust to various departures from normality; further it does not suffer from problems associated with normalization, since more is known about its asymptotic behavior; and furthermore, the power of the test is better than that of the EG test. We shall apply both in determining if long-run equilibrium relationship exists between FESC variables and import demand. They allow us to determine both short- and long-run relationships between the import demand and the explanatory variables. As a result, we are able to explain both policy implications and stability (long-run) for import demand for Guyana. Estimated coefficients of the explanatory variables for the short-run points to issues of policy implications in Guyana over the period of forty years for which data are available.

The remainder of this paper is organized as follows. Section 1 deals with the theoretical framework and develops a model to link Guyana's import performance to the growth in its national income and other channel variables. Section 2 addresses the collection of data, and the proposed method of analysis. Section 3 covers econometric analysis and findings. It presents the empirical results derived from estimating growth-in-imports equations. The final section presents summary and recommendations.

1. Theoretical framework and model development

1.1. Theoretical framework. There is a vast literature available on the import demand functions within the import-income-price-exchange rate nexus (see for example, Wells, 1968; Kreuger, 1983; Price and Thornblade, 1972; Jafar, 1981, 1995; Omojimite and Akpokodje, 2010). There are broadly three theoretical underpinning perspectives as to the assessment of import demand function: (1) the elasticity; (2) monetarist; and (3) absorption (Omojimite and Akpokodje, 2010). Likewise in the methodological plane various methodologies have been and continue to be utilized in pursuit of replicating or expanding the findings within the related nexus. The purpose of this study is not a critique of methodologies. Rather it is intended merely to examine the

implications for import demand given the generation of and supply of foreign exchange through FESC. We will have a brief reference to the literature on import demand function.

The first theoretical underpinning is the elasticity approach. It has been concerned with both short-term and long-term response of imports to adjustment in prices by use of the exchange rate mechanism. The majority of studies are intent to discern if the sum of import, and export demand price elasticity is greater than unity to ascertain that the Marshall-Lerner condition is satisfied. When this condition is satisfied exchange rate policies can be used to correct balance of payments disequilibrium of a country (for example, see, Wells, 1968; Kreuger, 1983; Price and Thornblade, 1972; Jafar, 1995; Reinhart, 1995; Upadhaya and Dhakal, 1997; Wilson and Takacs, 1979; Cheong, 2003; Bahmani-Oskooee, 1986, 1998; Tang, 2002; Bahmani-Oskee & Kara, 2003; Narayan, and Narayan, 2010; Omojimite and Akpokodje, 2010). Indeed it is expected that devaluation may change the terms of trade, increase production, and switch expenditure from foreign to domestic goods (Aydin et al., 2004).

The second theoretical underpinning – the monetarist approach – focuses on income growth which raises the demand for importables initially to meet autonomous demand (consumption effect) for new products and subsequently to offset the failure of absorption capacity (production effect) in the country (absorption approach) (for example, see, Schott, 2003, Adam and Moutos, 2004; Hummels and Klenow, 2005; Kim, 1970; Omojimite and Akpokodje, 2010). Here balance of payment is the focus and again exchange rate policy plays a crucial role (this may occur in the case of relative price, where the change in demand for importable (exportable) goods is greater than the change in demand for exportable (importable) termed "export biased" ("import biased") ones (Kim, 1970). As such the absence (availability) of foreign exchange would lead to foreign exchange constraint (surplus). The absence of foreign exchange (in the short term was found to play a significant role in trade flows (Reinhart, 1995) while buttressing exchange rate policies of devaluation (Jafar, 1981). Devaluation (appreciation) of a currency will increase prices of importables (lower prices of exportables) and dampen (increase) the volume and composition of imports (exports) available to consumers (producers) while increasing savings in foreign exchange (Bahmani-Oskooee, 2003). Germany's (Northern Europe) over-exporting to Greece's (Southern Europe) over-importing represents a classical example of the impact of foreign exchange behavior in a market economy of trade liberalization. The results end up as a disequilibrium outcome as Southern Europe ends up in debts and deficits.

The third theoretical basic – the absorption approach – concerns a policy in support of strengthening production and institutions' macro-economic fundamentals in the domestic economy. Policies that are in some instances driven by political motivation to boost (dampen) growth of income will raise (lower) the demand for importable (exportable) goods. These will have a consumption (production) effect that can be termed "import biased" ("export biased") (Meier, 1968, p. 33). In this scenario substitutes are considered to replace imported (exported) industrial supplies (Cheong, 2003). Here outright prohibition of importation (within import substitution industrialization model) is coupled to the instrument of devaluation. The latter may lead to movement in relative prices (import prices/export prices) that triggers import substitution and leads to foreign exchange savings (Kim, 1970, p. 136). Foreign exchange generation (constraint) and conservation (losses) could occur also through backward and forward linkages with other industries (Kim, *ibid*, 136) as externalities of effect of devaluation.

An acceptable summary of studies dealing the traditional import demand functions could be obtained from Tang (2002), and Aydin, Ciplak, and Yucel (2004). We focus simply on the investigation of the behavior of import demand in the presence of additional available foreign exchange as provided through the FESC which are institutional-based initiatives; and which allow for the modeling of import demand functions with variables related to the concerns of UNCTAD since the early 1960s for adequacy of foreign exchange availability.

1.2. Model development. The simplest form of the import demand function is defined within the neoclassical model; and predicts import demand for open economies based on the relationship amongst changes of autonomous imports, national income and exchange rates. As such it permits the use of the fundamental market arguments and allows for the equilibrium price and quantity demanded for imports to be determined through the interaction of supply and demand for foreign exchange.

Several empirical studies have hypothesised a relationship between the rate of change of income, relative prices, and the demand for imports (Price and Thornblade, 1972). These studies specify a linear relationship between the various components of import demand within a production-function framework. As such, a basic import demand function that is established both theoretically and em-

pirically for income's role in the demand for imports may be written as a minimalist model of import demand as follows:

$$MD = f(GNI, XR), \quad (1)$$

where *MD* is imports, *GNI* represents a country's total income as a population that owns factors of production, and is called gross national income (*GNI*), and *XR* represents the real exchange rate of a country. The discussion surrounding the estimation of equation (1) assumes global market conditions are in place and as such imports increase autonomously with increase in income. We formulate our first hypothesis as:

Hypothesis 1: Influence of income growth will be positive and significant on import demand.

Further, there are appropriate institutions to facilitate actions from a policy perspective. For example XR adjustment becomes a monetary policy instrument, which governments utilize in pursuit of development and balance of payments goals. The adjustment affects income and prices concurrently. With the basic emphasis on devaluation the intent is to reduce imports, increase exports and improve the level of FER. The behavior of import flows to XR changes was confirmed from three perspectives: (1) they were found to respond more quickly than relative prices for emerging and more developed countries (Wilson and Takacs, 1979; Bahmani-Oskooee, 1986); (2) their response to changes in prices was shorter than to changes in XR (Tegene, 1989, 1991) for developing economies; and (3) no startling and surprising results (exchange rate versus relative prices) for the developed countries were found. The flows in different countries were observed to react differently to country specific economic fundamentals (Bahmani-Oskee & Kara, 2003, Gafar, 1981; Krugman and Taylor, 1978). Further, through the multiplier process, devaluation may provide access to greater market size with the concomitant opportunities for economies of scale and scope – expanded exports. This results in stimulation of efficiency in the domestic economy. Imports could be boosted by XR changes. We formulate our second hypothesis.

Hypothesis 2: The influence of exchange rate will be positive and significant on import demand.

Beyond the autonomous imports argument, the absorption strand of the literature reveals that import demand is related positively to income (export prices) and inversely to relative prices of imports and domestic goods (Rusher and Wolff, 2009; Tegene, Bhoseem, Shrivani and Wilbratte, 1997). These could be captured by the use of terms-of-trade relationships between imports and exports as embedded in the normalization process of the export-to-import capacity (XCM) relationship. Notably, outward transfers to creditors in honouring foreign debt obligations in developing economies weaken exports' influences on import capacity (Kaminsky and Pereira, 1996; Krugman, 1988), dampen imports demand (Krugman, 1989) and consequently the growth process of small open economies such as Guyana.

Hypothesis 3: The influence of relative prices (export/imports) on import demand will be positive and significant.

The use of foreign exchange reserves in import demand modeling is justified on psychological as well as economic grounds (Butts and Mitchell, 2012). The level of foreign exchange reserves informs the expectations of borrowers and lenders of anticipated months of imports it guarantees, and determines their comfort level of the country's liquidity. In addition, the level of FER influences changes in the level of "input imports" in relationship to level of performance of exports. Here FER may arise (conservation) because of a reduction of imports (non-input imports being substituted with domestic goods) or a proportionately greater increase in exports over imports (terms-of-trade in favor of exports) or increase in capital inflows of the non-bank sector (monetary explanation) may materialized; or rescheduling of external debt or a combination of these (pressure on export earning is reduced. Further, FER also benefit from contributions of the IMF. As a lender of last resort in extreme case of FER shortfall, the IMF boosts foreign reserves through its provision in stand-by arrangements in support of the country. Countries, including Guyana, by holding a minimum level of net international assets are able to draw successive installments of its stand-by credit (Polak, 1997). Here past performance of foreign exchange reserves influence the terms placed on borrowing or suppliers' decision to finance trade in developing countries – Guyana is known to have faced severe FER in the 1980s. Hence we formulate the fifth hypothesis.

Hypothesis 5: The influence of FER will be negative and significant on import demand.

We consider that the collaborative efforts of international agencies represent the political economy dimension of international business. We place this in the import demand function of developing countries. Indeed, international agencies consider it an imperative for action in the affairs of developing countries based on the perceived weaknesses in their external sectors, such as deterioration of the terms-of-trade, global economic slowdown and/or

internal imbalances, inclusive of currency over-evaluation (Gross, 1966). This dimension is handled in collaboration with internal agencies (various government ministries and related policy makers). It also performs the "marriage between government and international agencies". The latter provides ODA inclusive of economic, humanitarian, human rights, and disaster relief. This comes in the form of cash, goods, or provision of services that would have required the outlay of foreign exchange. Indeed, ODA is an important driver of investment, economic growth, and development (OECD, 2006). Yet some caution is required that it has an effect on exchange rate in developing countries. It damages the exportability of manufacturing in developing countries (Rajan, and Subramanian, 2009). This provides an important quality to the association between domestic and international policy making institutions. For instance, except for 1997 Guyana has been almost totally dependent on ODA in the form of gross capital formation term "SACF". We formulate two more hypotheses.

Hypothesis 6: The influence of ODA on import demand will be positive and significant.

Hypothesis 7: The influence of the SACF on import demand will be positive and significant.

To control for the influence of these instruments one may recast equation (1) with addition of four variables as:

$$MD = f(GNI, XCM, XR, FER, ODA, SACF), \qquad (2)$$

where *MD* is the import demand, *GNI* is the gross domestic income, *XCM* describes exports-as-capacity to import, *XR* defines real exchange rate, *FER* relates to foreign exchange reserves, *ODA* represents official development assistance, and (*SACF*) represents the share-of-aid in gross capital formation[1]. The other variables are interpreted as in equation (2).

The model described in this section is an import demand function model characterized by several writers (for example, Doyle, 2004; and Jafar, 1981). Equation (2) is converted into its growth equivalent by log transformation of the dependent and independent variables. Thus, the model to be estimated is specified as:

$$\ln MD_t = \alpha_0 + \alpha_1 \ln GNI_t + \alpha_2 \ln XCM_t + \alpha_3 \ln XR_t + \\ + \alpha_4 \ln ODA_t + \alpha_5 \ln FER_t + \alpha_6 \ln SACF_t + \ln \mu_t, \qquad (3)$$

where, ln is the logarithm, and thus MD_t is the rate of growth of imports, GNI_t is the rate of growth of gross national income, XCM_t is rate of growth of the exports-as-capacity to import ratio; XR_t is rate of growth of exchange rate; FER_t is the rate of growth of foreign exchange reserves; $SACF_t$ is the rate of growth of the share-of-aid in gross capital formation; μ is a stochastic term that has the certain characteristic property namely, $E(u) = 0$; $Cov(u) = \sigma 2I$; and α_0 is a constant or intercept; and α_1, α_2, α_3, α_4, α_5, and α_6, are partial coefficients to be estimated. Equation (3) implies a constant elasticity equilibrium relationship.

2. Data collection and proposed method of analysis

2.1. Data. Time series data are collected from World Development Indicators CD ROM 2005 (WDI) of the World Bank Group for the period from 1960 to 2002 queried for Guyana over the forty three years period. In this study the variables of interest are imports of goods and services (import demand (*MD*)), gross national income (*GNI*), exports-as-capacity to import (*XCM*), official exchange rate (*XR*), official development assistance (*ODA*), foreign reserves (*FER*), and aid-as-a percentage of capital formation (*SACF*). The dependent variable is *MD*; while all the others are explanatory variables. The data are in constant local currency unit (LCU) (Guyana dollars), except for *FER*. We transform *FER* and *XR* to constant LCU. Estimation of the coefficients of the variables in the equations, and identification and diagnostic tests were carried out using EVIEWS © 5.1. Statistical package.

Stylized facts are given in Figure 1 (graphical description) and Tables 1 (descriptive statistics) and 2 (correlation).

2.2. Graphical description. In Figure 1 the graphs of the various variables show distinctively that they are structural problems and hence stationarity issues given the myriads of peaking and runs in the performance. Two distinct periods are pronounced – 1975-1976 and 1988-1992, respectively. The first period of 1975-1976, was the era of very high commodity prices (bauxite and sugar) – hence high export revenues. The likely impact of the size of export revenues could be seen as high levels of *XCM*, *MD*, *GNI*, and conversely as lows on the levels of *ODA* and *SACF*. The second period of 1988-1992, make the implementation of the SAP. It appears to have a distinctive influence on all with an increasing trend, but being very variable and irregular in *ODA* and *SACF* – the variables that are reflecting the direct influence of outcome of collaboration and cooperation among the official institutions (international and domestic) in the foreign exchange generating process.

[1] It is expected that capital contributions of aid impact enormously the macro-economic infrastructure of Guyana in the areas – water, roads, electricity, education and related technical assistance.

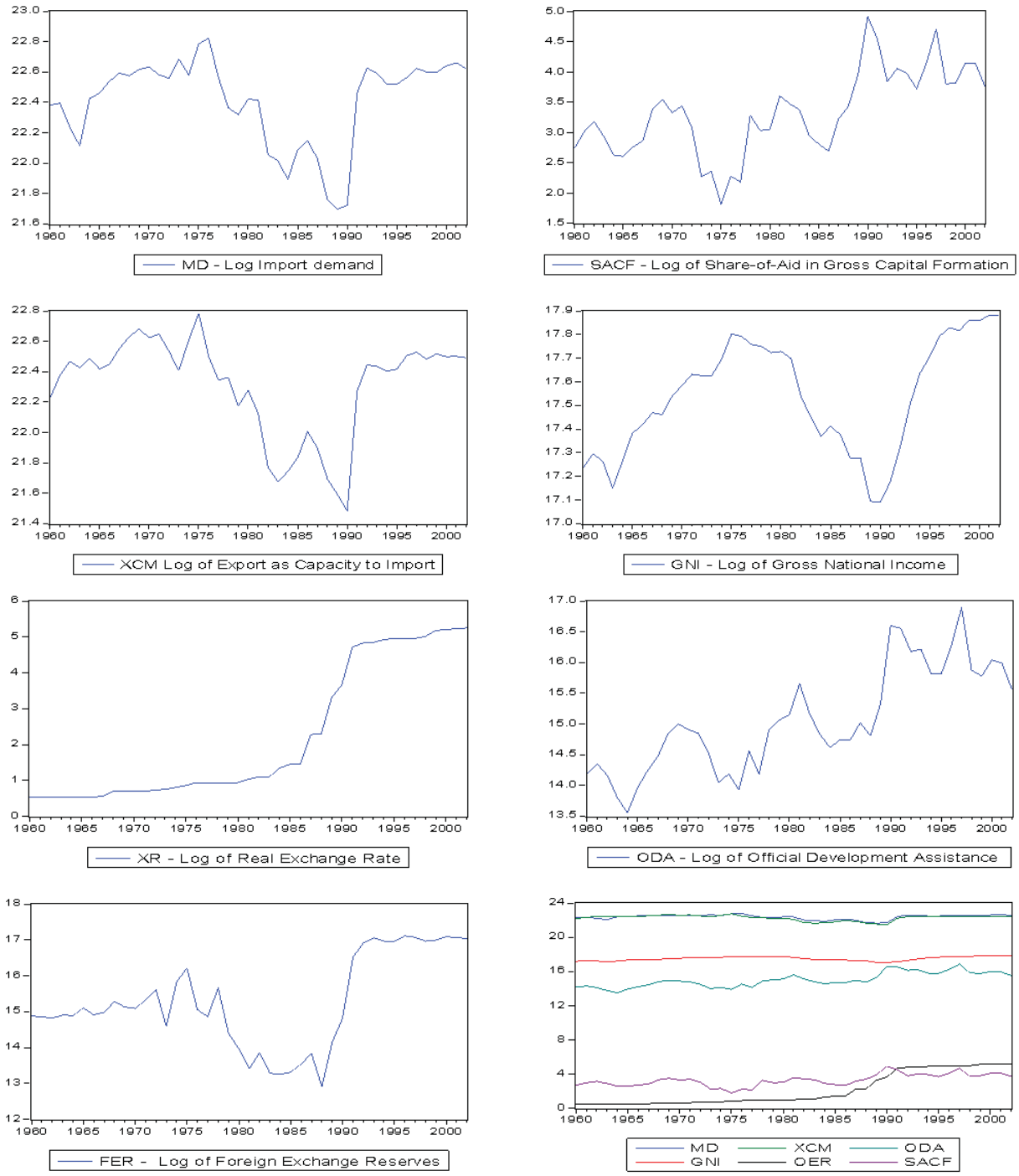

Fig. 1. Graph of seven foreign exchange supply variables

2.3. Tabular description. Considering the preliminary statistical treatment of the data, an assessment of results in Table 1 indicates that the variables overall do not show substantive change over the period – standard deviation is < 1 except for *XR* – exchange rates (1.895), and *FER* – foreign exchange reserves (1.29) and we do not consider them extreme in general statistical terms. While *XR* as a policy instrument is known to generate foreign exchange more directly or indirectly on what we call "the conservation mechanism (domestic switching and the absorption effect), *FER* is known to be instrumental (expectations) to the terms suppliers offer for financing imports. We cannot rule out normality for the variables except for MD_t, XCM_t, and XR_t. The normality of XR_t is threatened by the JB-statistic (p-value = 0.0346) while that for the others have the additional burden of very high skewness as well as mesokurtic, i.e., kurtosis > 3, indicating annual performances extreme from their respective means. This suggests that the distribution of the observations is influenced by extreme values (shocks to the supply of foreign exchange). Further, these statistics compound the observations in the graphical depiction showing distinct peaks in Figure 1, especially around the period of 1988-1992.

Table 1. Descriptive statistics of foreign exchange supply variables

	MD	*GNI*	*XCM*	*XR*	*ODA*	*FER*	*SACF*
Mean	22.406	17.536	22.309	2.1861	15.055	15.266	3.3236
Maximum	22.823	17.882	22.784	5.2505	16.895	17.114	4.9150
Minimum	21.696	17.091	21.481	0.5390	13.550	12.909	1.8203
Std. dev.	0.2876	0.2380	0.3274	1.8957	0.8466	1.2965	0.6974
Skewness	-1.0529	-0.2132	-1.0859	0.7109	0.3431	0.0415	0.1264
Kurtosis	3.1651	1.8261	3.0771	1.6842	2.1953	1.9071	2.6414
Jarque-Bera	7.9952	2.7945	8.4624	6.7238	2.0041	2.1522	0.3448
Probability	(0.018)	(0.247)	(0.014)	(0.034)	(0.367)	(0.340)	(0.841)

The correlation between import demand and the other variables is interesting. In Table 2 MD_t is correlated highly with the GNI_t, XCM_t and FER_t, respectively, at the nominal 5% level of significance. The positive relationships between MD_t and GNI_t, XCM_t, FER_t, XR_t, and ODA_t, respectively, imply that import demand increases with growth in gross national income, exports (favorable terms of trade), foreign exchange (positive shocks to the supply of foreign exchange – both policy and net export revenue/ and other balances) reserves, and favorable exchange rates, respectively, in Guyana. However, an increase in *SACF*, share of aid in gross capital formation leads to a decrease in import demand. The highest correlation, 0.91, is with XCM_t, but does this suggest causation?

Table 2. Correlations matrix

	IMP	*GNI*	*XCM*	*OER*	*ODA*	*FER*	*SACF*
MD	1.000000	0.671357	0.912818	0.128403	0.041217	0.671816	-0.142033
GNI	0.671357	1.000000	0.518035	0.278829	0.236643	0.490215	-0.002138
XCM	0.912818	0.518035	1.000000	0.012854	-0.112841	0.656714	-0.175203
XR	0.128403	0.278829	0.012854	1.000000	0.853359	0.702426	0.767656
ODA	0.041217	0.236643	-0.112841	0.853359	1.000000	0.516097	0.907998
FER	0.671816	0.490215	0.656714	0.702426	0.516097	1.000000	0.437377
SACF	-0.142033	-0.002138	-0.175203	0.767656	0.907998	0.437377	1.000000

3. Econometric analysis and results

We pursue the objective of estimating an import demand function for Guyana by establishing rather significant relationship exist between import demand and the FESC variables *MD*, *XCM*, XR, *ODA*, *FER* and *SACF*.

3.1. Analysis. Analysis involves multiple steps using the single equation (static) model to estimate the long-run equilibrium relationships and error correction mechanisms (dynamic) to capture the short-run dynamics in an import demand function for Guyana. The existence of long-run equilibrium relationships requires that there must be stationarity among economic variables. An error correction mechanism exists if these variables are non-stationary, but are integrated to the same degree and cointegrated. The latter serves to adjust errors (shocks) such that the system returns to its long-run relationship, or at least prevents them from becoming larger and larger (Charemza and Deadman, 1992). The long-run equilibrium is determined in three steps – determine the order of integration (unit root), estimate the cointegrating regression(s), and if the series are cointegrated construct the error correction model (ECM).

Models related to the Engle-Granger (EG) (1987) two-step approach, the autoregressive distributive lag (ADRL) and the Johansen-Juselius (JJ) (1990) vector autoregression (VAR) procedure underpin the construction of the related models. These approaches are germane in the determination of cointegration in the context of Guyana. Time series for Guyana are known to be non-stationary $I(1)$ in levels but first-differenced stationary $I(0)$ (Modeste and Butts, 2005; Butts 2006, Hardy, 2001).

3.2. Unit root – first step. Spurious regression occurs when one uses non-stationary time series data to estimate relationships amongst variables (Granger and Newbold, 1974). To avoid this, we employ the Augmented Dickey-Fuller (ADF), and the Philip-Perron (PP) tests to determine if there is a unit root in each series. We reject the unit root hypothesis if the estimated τ-statistic is greater (negatively/positively) than the critical value tabulated for the five percent level of significance (Hill, Griffiths and Judge, 2001; Enders, 2004). Table 3 shows the results of the tests for a unit root null hypothesis (H_0) against a stationary alternative (H_1). As shown, for all of the variables in levels, we cannot reject the unit root null hypotheses. We first differenced the variables of import demand, *GNI*, *XCM*, *XR*, *ODA*, *FER*, and *SACF* tend to be integrated of order one I(1). This result is consistent with findings of Modeste and Butts (2003) and Butts (2006). Thus, the variables of interest are first-differenced stationary

at the five percent level of significance. At this phase, each of the above variables appears to be stable and converging toward their individual means. Thus, the data satisfy the major condition for moving to the second step for constructing a cointegrating system. For this purpose, the EG and JJ approaches will be utilized separately.

Table 3. Unit root tests – estimated period: 1960-2002

Variable	Adjusted Dickey-Fuller		Phillips-Perron	
	(ADF)	δ	(PP)	δ
Differenced	(0)	(1)	(0)	(1)
Value of imports	-1.64	-3.83	-1.97	-6.71
Gross national income	-1.91	-5.06	-1.82	-5.04
Exports as percentage of import	-1.68	-5.45	-1.81	-5.42
Official development assistance	-3.11	-6.46	-3.24	-6.86
Real exchange rates	-2.441	-7.87	-2.44	-8.18
Foreign reserves	-1.001	-6.64	-1.011	-6.65
Share-of-aid in gross capital formation	-1.996	-6.44	-2.04	-6.44

Notes: The variables are in logs. * Denotes significance at the one percent levels. The McKinnon (1999) critical values reported for these results are -4.186 at the one percent level.

3.3. Cointegration – the second step: EG approach. The EG approach requires a two-pronged procedure to determine if a cointegrating relation is represented in a combination of the *I*(1) integrated series. First, we test if the Equation (3) exhibits a long-run steady state relation, i.e., an equilibrium relationship. Second, we confirm the relationship by performing the ADF test for cointegration on the residuals to see whether we can reject the null of no cointegration. The latter represents short-term deviations from the long-run equilibrium relationship. If the residuals are found to be stationary, i.e., *I*(0), then the series are considered cointegrated, and we use them as the error correction term (ECT) in a cointegrating vector (Johnston and DiNardo, 1997, p. 266; Hill et al., 2001).

The estimates of the variables in levels in equation (3) facilitate answers as to whether or not the coefficient of each explanatory variable has both the expected sign and a statistically significant effect on the dependent variable MD. We estimate equation (3) and found a stable-long-run relationship between MD and the FESC variables, i.e., the ADF statistic of the residuals rejects the unit root hypothesis. The intervention of the IMF and World Bank with a structural adjustment program to offset poor macro-performances leads us to modify the equation to account for the intervention. With this purpose in mind we augmented equation (3) to control for the structural adjustment program (SAP), and transformed it to natural logarithmic form and estimate it using the OLS method. It is expressed in equation (5) as follows:

$$\ln MD_t = \alpha_0 + \alpha_1 \ln GNI_t + \alpha_2 \ln XCM_t + \alpha_3 \ln XR_t + \\ + \alpha_4 \ln ODA_t + t\alpha_5 \ln FER_t + \alpha_6 \ln SACF_t + \\ + \alpha_7 SAP_t + \varepsilon_t, \quad (5)$$

where SAP_t is the structural adjustment program changes which has value of 1 for the period from 1989 to 1992 and 0 for all other time periods. All other variables are the same as defined in equation (3). The partial coefficients α_1, α_2, α_3, α_4, α_5, and α_6, are estimated coefficients which are elasticities of imports with respect to the corresponding variable; α_0, is the intercept, and εt is the white noise (independent of *MD*) residuals of zero mean [$E(u_i \backslash X_i) = 0$] and constant variance (normal) (σ^2) These representations and assumption are applicable, unless stated otherwise, to all other equations used in this study. The results are in Table 4.

Essentially, Table 4 presents the results for equations. These represent collectively the examination of the model, equation (5), for the long-run relationship between *MD* and *GNI*, *XCM*, *XR*, *ODA*, *FER*, *SACF*, and *SAP*.

Table 4. OLS regression long-run results, dependent variable *MD*

Variable	(1) 1960-2002	(2)ADRL 1960-2002
C	2.543 [1.249]	0.421 [0.164]
GNI_t	0.09 [1.149]	0.816 [3.589]
XCM_t	0.684 [6.582]*	0.56 [4.459]*
XR_t	-0.0141 [-0.677]	0.183 [2.089]**
ODA_t	0.227 [4.446]*	0.135 [1.491]
FER_t	0.019 [0.5701]	-0.066 [-1.632]
$SACF_t$	-0.235 [-4.480]*	-0.147 [-1.692]**
SAP_t	-0.022 [-0.363]	-0.080 [1.066]
MD_{t-1}		0.335 [1.891]***
GNI_{t-1}		-0.56 [-2.097]
XCM_{t-1}		-0.478 [-4.238]*
XR_{t-1}		-0.203 [-2.236]**
ODA_{t-1}		-0.077 [-0.881]
FER_{t-1}		0.076 [1.948]***
$SACF_{t-1}$		0.109 [1.258]
		0.072 [0.593]
Adjusted R-squared	0.9187	0.938
SER	0.081	0.072
F-statistic	73.65	42.39
DW	1.635	1.907
Misspecification tests		
ADF- τ	-5.381734	-5.505
Jarque-Bera (Normality)	0.545 [0.761]	0.42 [0.80]
Breusch-Godfrey(2) LM	4.494 [0.105]	3.631 [0.162]
ARCH(1)	1.115 [0.29]	0.108 [0.741]
White Heteroskedasticity	15.83 [0.256]	29.67 [0.378]
Chow Forecast Test	17.39 [0.235]	
Chow Break Point	16.43 [0.036]	
Ramsey Reset(1)	1.857 [0.1729]	1.29 [0.25]

Note: All the numbers in parenthesis […] are t-statistics; * (**) denote significance at 5% error level and lower and 10%, respectively.

The results for the period of 1960-2002 are in column (1) in Table 4. The results reveal that *GNI*, *XCM*, *XR* (negative), *ODA*, and *FER* have the expected signs for the estimated coefficients. The signs for *SACF* and *SAP*, on the contrary, are negative. Three variables are statistically significant – *XCM*, *XR*, and *SACF* at the one percent error level of significance. *GNI* with a t-statistic of 1.149, and using the rule considered the information of the variable with a t-value > 1. We interpret *GNI* as very important to *MD*. These indicate that import elasticities with respect to *XCM*, *ODA* and *SACF* are the key determinants of imports demand.

We recognize that the above inferences are sensitive to parameter instability, serial correlation in residuals and possess residual skewness. The ADF test (τ-value is 5.34) of the residuals rejects the unit root hypothesis and confirms that a stable long-run relationship exists between import demand and the FESC variables during the forty year period (1960-2002). The residuals survived tests for non-normality, and serial correlation, and heteroskedasticity. Interestingly, the Chow break point and Chow forecast test yield conflicting results. Both the F-statistics (not reported) and the log likelihood ratio (LR) test for the Chow forecast test failed to reject the null. On the other hand, for the Chow break point test, the LR test rejected a null hypothesis of no structural change in the import demand function before 1989 and after 1989 in Guyana, while the F-statistic rejected it. However, to the contrary, the Ramsey Reset test supports stability of the structure at seventeen percent (0.17) probability level of significance. This indication of instability of parameter is supported by both the CUSUM and the CUSUMSQ in Figure 3. Given the outcome we could describe the MD function for Guyana as unstable as tested with mere static FESC variables. Guyana experienced structural shocks to the system due a series of poor macro-economic and political policy decisions made in a hostile global environment. This should be no surprise. However given that the model is somewhat robust to residual kurtosis and heteroskedasticity we have accepted the results. We say in the long-run *XCM*, followed *SACF* and *ODA*, respectively. These are the FESC determinants of import demand.

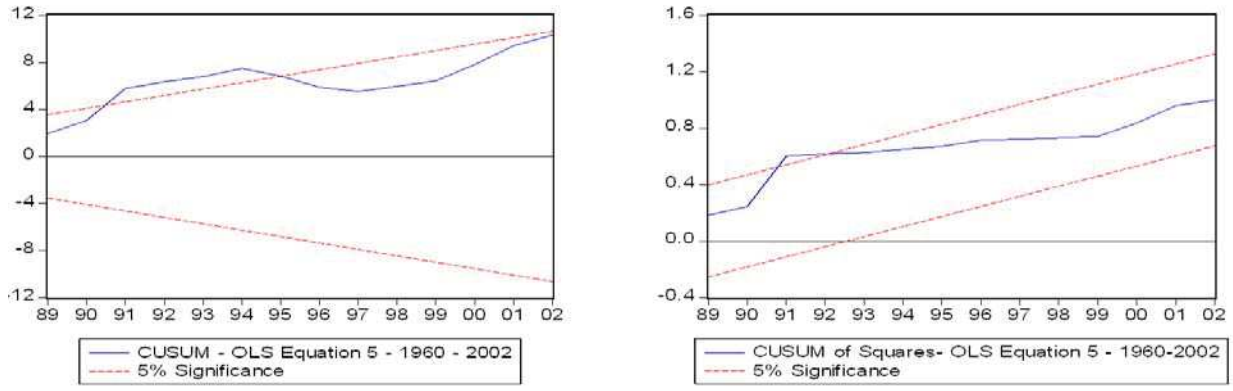

Fig. 2. OLS, recursive estimates, long-run equilibrium (1960-2002)

We anticipated a greater response (signaled by higher coefficient) of import demand to *GNI* that reflects the impact of remittances of Guyana" citizens living abroad which we considered would have increased the demand for imports. It is possible that higher rates of unemployment during the period dampen the impact of remittances on income; or remittances was used to purchase domestic goods and services; or went toward savings. Second, the high *ODA* and *SACF* elasticities for the period of 1960-2002 suggest higher correlation between import demand and these variables (see Table 1). This may reflect a dimension of the integration of the Guyana's economy with actions of international agencies that have oversights for the economy.

3.4. Auto-distributed lag (ADRL). We test the rigor of the long-run (equilibrium) regressions using a distributive-lagged model process. We expect to find similar results, i.e., supportive of a long-run equilibrium relationship among import demand and the FESC explanatory variables elasticities while controlling for the distributed lag effect (Johnston and DiNardo, 1997, p. 278). How sensitive is *MD* to contemporaneous changes (*t*) and a one-period lag (*t*-1) in the change? To determine this, we estimate a general autoregressive distributed lag model (ARDL) for equation (6). This is modeled as an unrestricted ARDL (*n*) model for the variables as follows:

$$MD_t = \alpha_0 + \sum GNI_t + \sum_{i=0}^{n} \beta_{2i} GNI_{t-1} + \sum XCM_t + \sum_{i=0}^{p} \beta_{3i} XCM_{t-1} + \sum XR_t + \sum_{i=1}^{m} \beta_{4i} XR_{t-1} + \sum ODA_t + \sum_{i=1}^{m} \beta_{5i} ODA_{t-1} +$$
$$+ \sum FER_t + \sum_{i=0}^{p} \beta_{6i} FER_{t-1} + \sum SACF_t + \sum_{i=1}^{m} \beta_{7i} SACF_{t-1} + \sum \beta SAP_t + \sum_{i=1}^{m} \beta_{8i} SAP_{t-1} + \phi_1 MD_{t-1} + \mu_t, \quad (6)$$

where the estimated import demand elasticity is a function of the contemporaneous elasticities, their one-period lag and lag of itself.

The results of equation (6) are in column (2) (ARDL 1960-2002) of Table 3 support the general findings of equation (5) for the period of 1960-2002. The contemporaneous influences of the *GNI*, *XCM*, *ODA*, *FER*, *SACF* and *SAP* elasticities, respectively, on import demand. *XCM* and *SACF* are statistically significant in both models. We note that *ODA* is significant only in the OLS static long run, while *FER* and *SAP* are insignificant but important (t = -1.632 and -1.066, respectively) in the ARDL. There is reversal in the relationship between import demand and *XR*. For the *ARDL*, *XR* is positive and significant indicating that as exchange rate appreciates import demand increases. This is in line with expectation of the role of exchange rate in the general literature. The contemporaneous FESC variables as determinants of import demand under the *ARDL* are *GNI*, *XCM*, *XR*, and *SACF*.

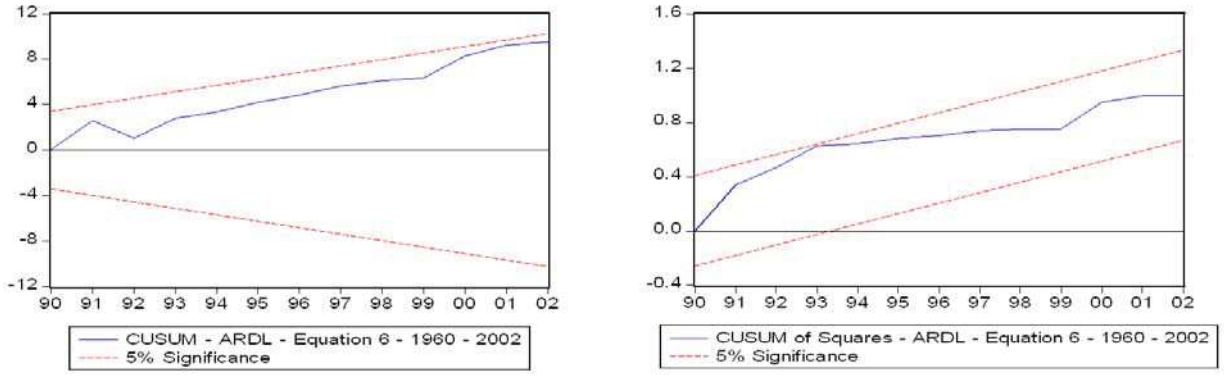

Fig. 3. ARDL, recursive estimates (1960-2002)

In terms of one-period lagged influences, the finding indicates that import demand has significant lag response at the 5 percent error level in regards to *XCM*, and *XR*, with *FER*. Its own lag (MD_{t-1}) is weakly significant if the significant level is relaxed to 10 percent. In all the models, we reject the hypothesis that the residuals have a unit root. In addition, the diagnostic tests presented in relevant columns of Table 3 indicate that the model is normal, without problems of specification, or parameter instability or variance constancy – CUSUM and CUSUMSQ tests (see Figure 8). We know that if the import demand function is stable, it can be implied that import multipliers are stable and that FESC authorities or sources can make foreign exchange generating and allocation policies with greater confidence regarding their impact on the macro economy and import demand. Indeed this evidence for OLS of parameter inconsistency (variance instability) is not surprising. However, given the findings of the ARDL, we accept that the variables are cointegrated and that a long-run equilibrium relationship exists. Therefore, an error correction representation of the elasticities is present (Engle-Granger, 1987).

3.5. Error correction model – the third step: single equation Engle-Granger. Given that the variables are integrated of order one $I(1)$, we proceed to test for cointegration (a long-run relationship) amongst import demand and the other explanatory variables directly in keeping with the context of Engle-Granger (1987) position. Accordingly, one can use the residuals of the long-run cointegrated equations as the error correction term in a dynamic autoregressive model. This permits an estimate of both the short-run dynamics and the long-run relationship. Using this approach, we estimated restricted error correction model (RECM, equation (7)) and un-restricted error correction model (URECM, equation (8)), respectively.

3.6. Restricted error correction model. We estimate a restricted error correction model for import demand and the other variables without a trend. A one-period lag for the dynamic terms (i.e., the lagged variables in first difference form) is used. We model this representation in equation (7):

$$\Delta \ln MD_t = \beta_0 + \sum_{i=0}^{n} \beta_{1i} \Delta \ln MD_{t-1} + \sum_{i=0}^{p} \beta_{2i} \Delta \ln XCM_{t-1} + \sum_{i=1}^{m} \beta_{3i} \Delta \ln XR_{t-1} + \sum_{i=1}^{m} \beta_{4i} \Delta \ln ODA_{t-1} \sum_{i=1}^{m} \beta_{5i} \Delta \ln FER_{t-1} + \\ + \sum_{i=1}^{m} \beta_{6i} \Delta \ln SACF_{t-1} + \beta_{7i} SAP_{t-1} + \beta_{8i} Ect_{t-1} + \mu_t. \quad (7)$$

Equation (7) is a first-order VAR augmented with the single error-correction term (ECT_{t-1}), the speed of adjustment of the system. The estimated coefficients are in column (1) of Table 5. The results indicate that at least at the ten-percent error level of significance, the one-period lagged rates of growth

(dynamics) in *ODA*, *FER*, *SACF* and *SAP* elasticities are the statistically significant FESC variables. Therefore we identify them as the determinants of import demand in the short-run for the forty-year period while noting the importance of *XR* and *XCM*, respectively. We interpret these relationships as *MD* responding in the short-run to the changes in foreign exchange contributions generated from actions of international agencies (for example IMF, World Bank). Similarly, the negative relationship between *MD* and *SACF* suggests an "aid and matching-fund mismatch," which may affect disbursement and further allocation of the funds at international agencies. For example budgetary problems in Guyana or even temporary administrative "fall out" might have resulted in delays in disbursement and hence the "aid matching-fund mismatch" The positive relationship between *MD* and *SAP* elasticity suggests the economic recovery program, implemented in 1988 under the aegis of the IMF and the International Bank for Reconstruction and Development (World Bank Group), has been effective. It suggests also that policy dictates of government and international agencies are drivers of Guyana's import demand.

Table 5. Estimated error correction model: dependent variable ($\Delta \ln MD_{t-1}$)

Variables	(1) RECM (1960-2002)	(2) URECM (1960-2002)
C	0.012 [0.426]	12.18 [3.359]
$\Delta \ln GNI_{t-1}$	-0.114 [0.2826]	-0.092 [-0.221]
$\Delta \ln XCM_{t-1}$	-0.203 [-1.0271]	0.026 [0.158]
$\Delta \ln XR_{t-1}$	-0.172 [-1.288]	-0.204 [-1.481]
$\Delta \ln ODA_{t-1}$	0.443 [3.677]*	0.434[4.297]*
$\Delta \ln FER_{t-1}$	0.207 [3.519]*	0.040 [0.681]
$\Delta \ln SACF_{t-1}$	-0.448[-3.641]*	-0.484 [-4.711]*
SAP_{t-1}	0.218 [1.835]***	0.107 [0.740]
ECT_{t-1}	-0.398 [-1.044]*	
$\ln GNI_{t-1}$		0.098 [0.488]
$\ln XCM_{t-1}$		-0.081 [-0.336]
$\ln XR_{t-1}$		-0.091 [-2.332]**
$\ln ODA_{t-1}$		-0.005 [-0.882]
$\ln FER_{t-1}$		0.196 [3.032]*
LnSACFt-1		0.085 [0.830]
$\ln MD_{t-1}$		-0.672 [-2.500]**
Adjusted R-squared	0.307	0.63
SER	0.144	0.105
F-statistic	3.224 [0.0084]	5.631 (0.000)
DW-statistic	1.9329	2.294
Misspecification test		
ADF τ-statistic	-5.9820	-7.200
Jarque-Bera	1.003 [0.000]	0.791 [0.673]
Breusch-Godfrey	0.96 [0.616]	8.484 [0.0143]
ARCH	0.1466 [0.7017]	0.0435 [0.834]
White heteroskedasticity	32.057 [0.0098]	34.047 [0.237]
Chow Break Point 1990	19.50 [0.021]	
Ramsey Reset	0.394 [0.5306]	13.088 [0.0002]

Notes: All the numbers in parenthesis […] are t-statistic; *, **, *** represent 1%, 5% and 10% level of significance.

The ECT is in concurrence with convergence theory. It is negative but not significant statistically. Yet using the rule to "consider the message to be received from the variable with a "t-statistic > 1", we consider that the system (import demand in Guyana) made adjustments (negative/positive) to return to the long-run equilibrium after receiving shocks to the level of foreign exchange supply. This indicates the tendency of import demand to return to its long-run equilibrium but not enough to consider the response as significant long-term responses. As such we cannot identify any Granger-causality between *MD* and the FESC variables. We may test this later.

3.7. Unrestricted error correction model (URECM) – Engle-Granger. For purpose of comparison the unrestricted error correction model is formulated as in equation (8). Here we examine changes in import demand relative to lagged rates of change in the FESC explanatory variables elasticities and the one-period lagged of the levels of the these explanatory variables and the lag of itself (MD_{t-1}).

$$\Delta\ln MD_t = \beta_0 \sum_{i=1}^{n} \beta_1 \Delta\ln GNI_{t-1} + \sum_{i=1}^{n} \beta_2 \Delta\ln XCM_{t-1} + \sum_{i=1}^{n} \beta_3 \Delta\ln XR_{t-1} + \sum_{i=1} \beta_4 \Delta\ln ODA_{t-1} + \sum_{i=1}^{n} \beta_5 \Delta\ln FER_{t-1} +$$
$$+ \sum_{i=1}^{n} \beta_6 \Delta\ln SACF_{t-1} + \sum_{i=1}^{n} \beta_7 \Delta SAP_{t-1} + \beta_8 \ln MD_{t-1} + \beta_9 \ln GNI_{t-1} + \beta_{10} \ln XCM_{t-1} + \beta_{11} \ln XR_{t-1} + \beta_{12} \ln ODA_{t-1} + \quad (8)$$
$$+ \beta_{13} \ln FER_{t-1} + \beta_{14} \ln SACF_{t-1} + \beta_{15} SAP_{t-1} + \ln\varepsilon_{t-1}.$$

The estimated coefficients of equation (8) are in column (2) of Table 4. The results indicate that for the one-period lagged on changes in foreign exchange generated from FESC only *ODA* (positive) and *SACF* (negative) elasticities are statistically significant. Again in this model import demand responds positively to one-period lag in changes of *ODA* and negatively to the changes of *SACF*. The similar changes of *XR* are seen to be important (t-statistic = -1.48). These (*ODA* and *SACF*) are the FESC variables as determinants of import demand in the unrestricted short run.

In regards the lagged levels of *MD*, *XR*, and *FER* are statistically significant. Import demand responds negatively to the one-period lags of *XR* and itself (*MD*), and positively to *FER*. It is clear that import demand responds stronger to these variables relative to value and significance in the presence of lagged short-run (policy) shocks than for the contemporaneous influences (error) in the restricted model. The *GNI* elasticity is negative, while the *SACF* elasticity is positive. Our main interpretation of these findings is that import demand does not adjust to the influence of the one-period lagged levels of *GNI*, *ODA*, *SACF*, or *SAP* elasticity, respectively. For the lagged levels, *MD*, *XR* and *FER* elasticities are the key FESC variables as determinants of (*MD*) import demand in unrestricted error correction model. In this model we can expect *MD* to respond to one-period lags of foreign exchange generated through FESC as *XR* – by conservation and switching between domestic and non-input imported products, *FER* – increased favorable net position in current account of balance of payments, *ODA* – more effective development assistance demonstrated by allocation to the right projects, persons and for right reasons, and *SACF* – being technical, allocation of funds to the areas that demonstrate innovation and adoption for the integration of local economy in the global market place – increased comparative advantage.

3.8. Vector Autoregressive Analysis (VAR). We perform a VAR on the basis that the model is atheoretical (Sims, 1980). We have placed together a number of related international variables and hope to determine if a relationship exists. We rejoin phase one of the procedure to establish if a cointegration relationship exist between import demand and the foreign exchange channel variables. In this instant, we are interested in the number of cointegrating vectors. Since the variables are integrated of order one, i.e., *I*(1) (Table 1), we utilize the methodology of Johansen-Juselius (1991, 1995a) that used a VAR to test for multivariate cointegration as implemented in EVIEWS (c) 5.1. We consider the VAR of order *p*:

$$y_t = m + A_1 y_{t-1} + \ldots + Apy_{t-p} + \beta_1 x_{t-1} + \ldots \beta px_{t-p} + \varepsilon_t \quad (9)$$

where y_t is a k-vector of non-stationary *I*(1) variables, x_t is a d-vector of deterministic variables, the A is and B is are *k* x *k* coefficient matrices. *m* is the coefficient matrix associated with deterministic terms such as a constant, trend, and seasonal dummies; and ε_t is a vector of innovations that are assumed to be iid. Thus we estimate this VAR with an optimal lag of one. This lag was chosen in accordance with Schwartz Information Criterion (SC). The model includes the unrestricted constant and allows for a linear trend in the variables but not in the cointegrating vector. We report the results in Table 6.

In general Table 6 shows the correlations of changes related to the various FESC. We observed that the variables targeted as originating with international institutions *ODA*, *SACF* and *SAP* are correlated with their own changes in the previous period. No variable of "domestic origination" is correlated with its own previous changes. The results in column (1) shows clearly that demand for imports follows the previous changes in four of the six FESC variables – *XR*, *FER*, *ODA*, *SACF* and as well as *SAP*. The variables of "international origination" illustrate the strongest impact in the order of *ODA* (0.48), followed by *SACF* (-0.48), and *SAP* (0.23). The domestic variables *FER* (-0.21) and *XR* (-0.363) followed. All are statistically significant at least at the ten percent error level of significance. Interestingly, with a positive relationship the policy dictates under that *SAP* increased that demand of imports – a healthier economy.

Table. 6 VAR analysis of FESC in the domestic and foreign exchange channels

	D(*MD*)	*D*(*GNI*)	*D*(*XCM*)	*D*(*XR*)	*D*(*ODA*)	*D*(*FER*)	*D*(*SACF*)	*D*(*SAP*)
D(*MD*(-1))					-1.0014 [-1.098]		-1.4339 [-1.526]	-0.703 [-1.9]**
D(*GNI*(-1))		0.466 [2.78]**						0.553 [1.05]
D(*XCM*(-1))								
D(*XR*(-1))	-0.1795 [-1.218]	0.0715 [1.207]					0.639 [1.395]	0.3073 [1.664]
D(*ODA*(-1))	0.477 [3.284]*		0.433 [2.485]**	0.318 [1.3501]	0.605 [1.378]	0.623 [1.025]		
D(*FER*(-1))	0.2108 [3.180]*	0.0398 [1.492]					-0.227 [-1.103]	-0.108 [-1.308]
D(*SACF*(-1))	-0.4753 [-3.194]*	-0.088 [-1.474]	-0.404 [-2.268]**	-0.2539 [-1.054]	-0.741 [-1.65]	-0.653 [-1.051]		
D(*SAP*(-1))	0.233 [1.96]***	-0.101 [-2.11]**		0.561 [2.91]**	0.417 [1.157]	0.715 [1.43]		-0.259 [-1.73]
C				0.100 [2.08]**				
Adjusted R-squared	0.2886	0.4402	0.004	0.108	-0.104	-0.1007	-0.104	0.323
F-statistic	3.0293	4.932	1.019	1.607	0.528	0.5425	0.528	3.395

Note: One lag chosen by the SC criterion was used in VAR analysis. The t-statistics are in [….] *, ** and *** denotes statistical significance at the 1%, 5% and 10% respectively.

If the variables in the VAR in equation (9) are cointegrated there is a vector error correction (VECM) representation and places the a-theoretic relationship into a long term. We will not pursue the estimation of the VECM relationship. On the basis of the maximum-eigen value of an estimation that includes an intercept in the cointegrating equation the finding indicates 3 cointegrating equations at the 0.01 percent error level, i.e., $r = 3$ representing import demand, gross national income, and export-as-capacity to import. We report only findings for import demand. This is the variable of interest in this study. Thus, using the normalized coefficient values for import demand $MD = f$ (*GNI*, *XCM*, *XR*, *ODA*, *FER*, *SACF* and *SAP*). These represent long-run elasticity measures of the FESC variables in logarithms. The equation normalized is presented with the asymptotic standard error is in parenthesis as:

$$MD_t = \underset{(0.482)}{0.578GNI_t} + \underset{(0.348)*}{2.93XCM_t} + \underset{(0.166)*}{0.754XR_t} - \underset{(0.232)*}{1.57ODA_t} - \underset{(0.114)*}{1.25FER_t} - \underset{(0.207)*}{2.0SACF_t} + \underset{(0.218)*}{3.95SAP_t} \quad (9)$$

The above relations imply that in the long-run import demand relates positively and significantly to changes in the elasticities of *XCM*, *XR*, and *SAP*; and negatively to *ODA*, *FER* and *SACF*. Given the signs of the coefficient we interpret the cointegrating results as describing the long-run import demand for the period of 1960-2002.

We examine the impulse response (table not reported here for words) of *MD* to the FESC variable. The results indicate that *MD* from one-period impulse increases to changes in *MD*, *XCM*, *XR*, *ODA*, and *SAFC* whereas it suggests a unit impact leading to level change in the equilibrium for *GNI* and *FER*.

Further, we examine the issue of causality using the VAR Granger Causality/Block Exogeneity Wald Test. The findings in Table 7 show that import demand is Granger-cause jointly by all the FESC variables. This supports the findings of the *ECM*. There is specifically a unidirectional Granger-causality from *XR*, *FER*, and *SAP* to import demand. There is also reverse causality from *MD* to *FER*. Thus the modeling of import demand using the FESC variables is supported.

Table 9. Granger causality between import demand and FESC variables

Does not Granger-cause *MD*	Chi-square	df	Probability	Granger-caused?
XR	8.239311	1	0.0041	Yes
FER	14.63326	1	0.0001	Yes
SAP	2.037645	1	0.1534	Yes
Joint	26.67016	7	0.0004	Yes
Does not Granger-cause LFER				
LIMP	8.239311	1	0.046	Yes

Conclusions and implications

We employed time series techniques to investigate the relationship between import demand and the "foreign-exchange-supply channels" variables – *GNI*, *XCM*, *XR*, *ODA*, *FER*, *SACF* and *SAP*. This study tested the hypothesis that import demand and the FESC variables (collectively) have a static long-run relationship using cointegration, autoregressive,

error correction, and vector autoregressive methodologies. The findings indicated that a long-run relationship is present between the import demand and the FESC variables. All of the methodologies support a joint long-run relationship between import demand and the FESC variables. Specifically, the identified determinants of import demand related to the respective methodologies are: (1) *XCM*, *XR*, *ODA*, *SACF* and *SAP* – OLS static long-run regression; (2) *XCM*, *XR*, *FER*, *SACF*, and lagged *MD* – autoregressive distributed lag (ARDL); (3) *ODA*, *FER*, *SACF*, and *SAP* – Engle-Granger two-stage restricted error correction model (RECM) test; (4) *XR*, *ODA*, *SACF*, and lagged *MD* – Engle-Granger two-stage restricted error correction model (URECM) test; (5) *ODA*, *FER*, *SACF*, *SAP* – vector autoregressive (VAR), and (6) *XCM*, *XR*, *ODA*, *FER*, *SACF*, and *SAP* – the Johansen maximum likelihood cointegration test.

The order of importance, measured by the number of times the variables were statistically significant ranked *XR* as top, followed by *ODA*, *SACF*, *SAP*, *FER* and *XCM*. Again, *GNI* was significant only for the short period of 1989-2002.

The findings that import demand is impacted by the availability foreign exchange in Guyana are encouraging and provide empirical evidence for utilizing FESC in modeling import demand functions. This is one of the most important findings of this paper because it provides empirical support for a hypothesis of the FESC variables in the long run. Thus, we conclude that the foreign exchange generation process in both domestic and international channels fit together for Guyana. The good showing of SAP is indicative that the policies of international agencies and the government of Guyana are influenced by the tenets of market and trade liberalization occurring in the global economy.

There are three major implications of our study for import demand and growth considerations for developing countries with similar experiences of foreign exchange constraints. First, the mostly-negative influences of *SACF* on import demand imply a situation in which government revenue constraints inhibited its matching of share-of-aid in gross capital formation. Thus, we may observe the problem of disbursement required in the IMF and World Bank conditionality. This may be typical in developing countries and suggests the necessity for relevant and realistic targets and programs to affect efficiency in the allocation and disbursement of aid and its matching support. Second, the implications for policy to maintain an efficient exchange rate and promote exports require effort to achieve and maintain fiscal and monetary disciplines. For example, Milton Friedman and Edmund Phelps advocated the delinking of exchange rates from central banks in order to promote their efficiency. Third, the allocation of the share-of-aid in gross capital formation, as a component of official development assistance, should be to programs and projects to affect the greatest positive impact for growth and development. The findings support the view for continuance of the efforts of international agencies toward support for growth and development in developing counties, since imports and economic growth are inter-linked.

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