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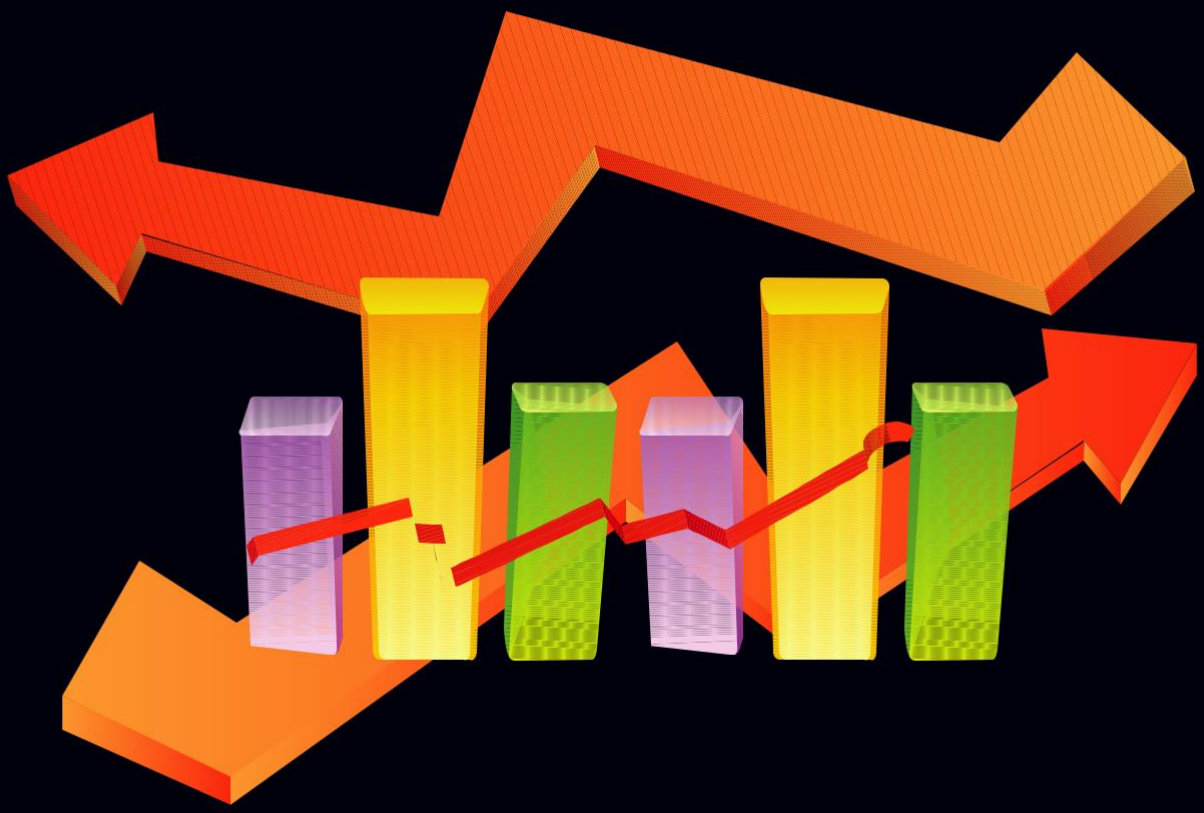
EXPORT AND IMPORT PRICE ELASTICITY FOR UGANDA: AN EMPIRICAL ANALYSIS



Alemayehu Gedda, Nathan Sunday, Rehema Kahunde, Ezra Munyambonera, Paul Lakuma, Brian Sserunjogi, Isaac Shinyekwa

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ABSTRACT

This paper applies Autoregressive Distributed Lag (ARDL) technique to estimate export supply and import demand elasticities for Uganda. Both aggregate and commodity specific elasticities are estimated with six export commodities and fifteen import commodities. To obtain commodity specific elasticities, ARDL models for each commodity are estimated separately using quarterly data for the period 2006-2018. Results suggest that Uganda's export supply does not respond to changes in relative price (both in the short run and long run) but rather to other factors such as capital formation and expected profit margins. However, considerable variations across commodities and time duration (short run and long run) have been observed. For instance, export for maize is found to have elastic supply (both short run and long run) while simsim is found to have inelastic supply in the long run. Regarding imports, our analysis shows that the long run price elasticity of demand is close to unitary while import demand is none responsive to price changes in the short run. Cereals, iron and steel, diary produce, and glass and glassware have fairly elastic demand in the long run and inelastic demand in the short run. The other commodities have inelastic demand in the short run and long run. The none-responsiveness of export supply to changes in relative price suggests presences of supply side constraints which have be addressed. In addition the variation in commodity specific import demand elasticities suggest that trade policies need to be selectively implemented.

Key words; Exports, Imports, Elasticities, Uganda

1. INTRODUCTION

Worldwide, price elasticities of export supply and import demand have received considerable attention given the current economic climate characterized by volatile markets and prices (Duffy *et al.,* 1990). Furthermore, these elasticities have a wide range of empirical implications on economic policy design for growth performance, international competitiveness, balance of payments equilibrium and industrial strategies of an economy (Ihsan *et al.,* 2015). Therefore, for appropriate economic policy design, an accurate estimation of elasticities is of great importance. However, researchers have not reached a consensus about the magnitude of these parameters as they vary across countries and across commodities. The variation in elasticities across commodities and countries can be attributed to methodological differences with some researchers using price as the only explanatory variable.

Just like many developing countries, Uganda's exports share in the world has been gradually deteriorating while that of imports has grown significantly. This has resulted into a widening current account deficit and constrained growth. For instance, according to World Bank[1], over the period 2006-2016, the country's average exports as a percentage of GDP stood at 18.7 percent while average imports as a percentage of GDP stood at 30.2 percent, creating a negative trade balance of 11.5 percent. Such a situation therefore makes it necessary to understand the response of export supply and import demand to changes in prices to guide the country in adoption and implementation of policies to improve its trade balance.

Studies which include Uganda in the sample have been skewed to import demand elasticities while ignoring export supply elasticities (for instance; Jones, 2008). Moreover, such studies are unable to account for the dynamic response of import demand to changes in prices. The other studies relevant to Uganda have remained silent about elasticities but rather focus on drivers of export supply and import demand. For instance; Mwebaze (2013) and Tumwebaze (2015) for export supply, and Ayodotun & Farayibi (2016) and Hyuya *et al.,* (2018) for import demand.

This paper therefore provides a systematic estimation of price elasticities for Uganda's exports and imports, both at aggregate and disaggregated commodity levels to investigate whether the country's export supply and import demand is price elastic or inelastic. The contribution of the paper is therefore twofold; first it estimates aggregate and commodity specific export supply and import demand elasticities while controlling for other macroeconomic factors (such as Gross fixed capital formation, GDP of trading partners, domestic GDP etc.); secondly, we apply a technique of Autoregressive Distributed Lag (ARDL) which allows us to disentangle the short run and long run elasticities to account for the dynamic response of quantity supply (exports) or demanded (imports) to changes in prices.]

Results of the analysis suggest that Uganda's export supply does not respond to changes in relative price (both in the short run and long run) but rather to other factors such as capital formation and expected profit margins. However, there exists considerable variations across commodities and time duration (short run and long run). For instance, export for maize is found to have elastic supply (both short run and long run) while sim-sim is found to have inelastic supply in the long run. Regarding imports, our analysis shows that the long run price elasticity of demand is close to unitary while the demand is none responsive to price changes in the short run. Similar to exports, considerable variations are observed across commodities and time duration (short run and long run). Cereals, iron and steel, diary produce, and glass and glassware have fairly elastic demand in the long run and inelastic demand in the short run. The other commodities have inelastic demand in the short run and long run.

The remainder of the paper is organized as follows; section 2 provides a review of related literature; section

1

3 highlights the theoretical underpinnings for estimation of export supply and import demand elasticities; section 4 presents econometric approach for the study; section 5 presents data and estimation results; while section 6 presents conclusion and recommendations for policy.

2. REVIEW OF RELEVANT LITERATURE

In spite of its importance, literature on export supply and import demand elasticities remains limited, probably due to data limitations. Nonetheless, a few studies can be spotted in the literature. A study by Olarreaga et al (2004) finds import demand elasticity to exhibit significant variation across countries and products. They found import demand elasticity to be higher at commodity level rather than the industry level. The authors also show that large countries tend to have more elastic import demands, largely attributed to availability of import substitutes. Overall import demand elasticity was estimated at -4 while that for Uganda was estimated to be -5.2. The study however didn't cater for the dynamic response of import demand to changes in prices since it doesn't provide short run and long run elasticities.

A study by Jones (2008) estimated overall import demand elasticities and commodity specific elasticities (based on 2-digit product lines defined by the Harmonised System) for ten African countries, Uganda inclusive. Similar to Olarreaga et al (2004), the study found considerable variations across countries and sector. The authors found import demand to be more elastic in sectors that have relatively high levels of domestic production and where there are exports. Overall, their results suggest that import demand in Africa is fairly elastic, with the coefficient estimates greater than unity. Import demand elasticity for Uganda was found to -1.2 (with OLS) and -0.9 (with fixed effect). Relatedly, Ghosi *et al*., estimated the import demand elasticities for 167 countries over 5124 products (at a six digit level of the Harmonised system) and their findings generally concluded that countries exhibiting the highest average elasticities belong to the economically most important countries in their respective regions, while countries with lowest import demand elasticities are typically island states. The results also revealed a contrast between countries that are rich in natural resources and those that are not; that is, countries that are rich in natural resources face more inelastic import demand as compared to their counterparts that are not resource-rich. Similar to Olarreaga et al (2004), these studies did not account for short run and long run dynamics

Furthermore, Arize (1986) who used a simultaneous model to study the supply and demand for imports and exports for eight developing countries found export price elasticities to be smaller in a sample of only African countries, implying the response of export demand to export prices is weak in Africa. He however found that import prices to have a significant effect on the quantity of imports demanded.

The other available studies in the literature have concentrated on explaining factors driving export supply and import demand in Uganda. For instance, Mwebaze (2013) reported that the major factors determining the level of exports supply at macro level were capacity of the economy to produce output, relative movement of prices at home and abroad, and domestic investment. At the firm level, the key factors were labour productivity, capital, firm size investment per worker, source of finance, sector, managerial experience, capacity utilisation, and legal status of the firm. While using augmented gravity model, Tumwebaze (2015) found that Uganda's GDP, importer's GDP, importer's GDP per capita, per capita GDP difference between Uganda and its trading partners, real exchange rate, official common language, and contiguity have a positive and statistically significant effect on its exports. The study further, shows that the formation of COMESA and EAC had a significant positive effect on Uganda's exports. The study however indicated that GDP per capita and distance between Uganda and its trading partners had a negative effect on Uganda's export flows.

Regarding import demand, Ayodotun & Farayibi (2016) used fixed effects and random effects estimations for

a panel of sub-Sahara African countries to model the elasticities of aggregate imports and their components both in the short run and long run. The findings indicate that domestic income, foreign exchange reserves and trade liberalization all play significant roles. Additionally, a study by Gaalya *et al*., (2017) established the effects of trade openness on both aggregated and disaggregated imports for East African countries and the findings confirmed that tariff rate reduces imports and exports both at aggregate and disaggregate levels. They further confirmed that an increase in income and prices positively influence aggregate and disaggregate imports while real effective exchange rate has a negative influence on the same. In the same vein, Hyuya *et al.,* (2018) who analyzed the determinants of import demand for rice in Uganda concluded that population, domestic rice production, own price and own consumption were found to be significant and therefore influencing rice imports in Uganda.

3.0 THE THEORETICAL FRAMEWORK

3.1 The Export Supply Model and Export Price Elasticities

One of the underlying questions that needs to be answered to come up with export elasticities is what determines the supply of primary commodity exports? From the literature, these factors include cost and accessibility of consumer goods, farm subsidies and taxes, research and extension, infrastructure, investment in the sector, logistics, access to credit, among others (Alemayehu, 2002). Although literature on commodity export supply functions starts from structural equations, which accommodate a wide spectrum of these factors, the estimated reduced form equations are generally price-focused; they include either current or lagged (relative) prices. The price-focused supply models stem from Nerlove's (1958) model. Nerlove describes the dynamics of agricultural supply, in particular, by maintaining the assumption that producers are influenced by their perception of normal price, which is captured through adaptive price expectation mechanism. Consequently, production is a function of prices and other adjustment costs.

Alemayehu (1999) conducted a review of literature on the supply of primary commodity exports, and indicated a distinction between the long run (potential supply) and the short run (a proportion of potential supply). In the review the study noted that some studies define the structural equations of supply as the sum of utilisation of potential output (*the utilisation* rate approach) and the potential output (*potential supply* approach). However, the reduced form model is specified as a function of current and lagged prices, exchange rate and a supply shock indicator. Such classification is used for perennial crops and minerals as well. As indicated in Alemayehu (1999), classic commodity models that include other factors other than price include Ady (1968). In this model, the existing acreage (stock of crop) in the previous period is included as additional explanatory variable. In the 'liquidity model', farmer's income is incorporated as an additional variable indicating capacity to invest. The latter relates investment to the difference between desired and actual level of capital. Such models have been summarised under models based on capital and investment behaviour theory presented in the Nerlovian adjustment model (Alemayehu, 2002).

Alternative forms of this theory arise in specifying the factors that determine the desired level of capital stock. These include capacity utilisation (capacity utilisation theory), net output or return to capital (neo-classical), internal cash flow (liquidity theory) and expected profit-based approach (Alemayehu, 1999). Some studies consider supply as a function of expected price, expected opportunity cost, production costs, stock of output (trees in the case of perennial crops), potential of the industry and tax considerations (for example Kalaitzandonakes *et al.,* 1992). Others incorporate the dynamic effects of the exchange rate, the general price level, and an index of productivity (Bond, 1987).

Most studies on the exports of African countries tend to follow a similar approach. For small African countries,

the earliest model of Rwegasira (1984); see Alemayehu, 1999) shows that for the period 1960s–1970s, the short run elasticities are high for annual crops while long-run elasticities are high for tree crops and minerals. Although there is a wide range of factors that have been identified as affecting supply of primary commodities, most studies empirically tend to narrow these factors to price variables, indicating the difficulty of quantifying non-price variables or obtaining reliable and complete set of data (Alemayehu, 1999; Mckay *et al.,* 1998; Branchi *et al,* 1999).

In addition, there is a tendency to ignore the influence of the non-agricultural sector, therefore implicitly assuming that the interactions between the two sectors are insignificant. Nonetheless, the bias of literature on supply-side reflects the dominance of the small country assumption, according to which countries have a negligible weight in the world market. But generally, early time series studies have tended to produce rather low empirical estimates of elasticities (Mckay *et al.,* 1998. Finally, conventional commodity models usually incorporate the real foreign income (of trading partners) and real exchange rate (proxy for relative prices) as explanatory variables in the estimation of the export supply functions in general (Ndung'u and Ngugi, 1999; Alemayehu, 1999; Balassa *et al.,* 1989; Branchi *et al.,* 1999, Mckay *et al.,* 1998, among others).

The above review provides insight into some important points in specifying export functions of primary commodities. Firstly, factors other than price are found to be important determinants of commodity supply. However, either lack of data or difficulty in quantifying this data, as well as having to focus on reduced forms, forces many researchers to use prices as the only explanatory variables. Secondly, a distinction across commodities, at least between annual and perennial crops, is essential. A third and relatively neglected point is the need to place the commodity market within a macro framework where the role of stock holding and the impact of macroeconomic variables is likely to be important[2].

2 See Alemayehu (2012): form classic models. Hwa (1985) represents a good example of a study, which includes stock holding variables within commodity models, while Alogoskoufis and Varangis (1992) include macro variables in their commodity model.

In this study the export supply equation of a typical African economy is specified. We have further assumed that output of export commodities and exports respond to world prices in a broadly identical manner[3]. Although government intervention within the export sectors of most African countries is obvious, it is assumed that the impact of change in world price will send similar signals, both to the public and private sectors engaged in the sector. The response to price and other supply factors is likely to take two forms (Alemayehu, 2002). In the short run, increased capacity utilization is important. Thus, *short-run* parts of the argument would theoretically be based on the commodity model of Goldstein and Khan (1978), Chu and Morrison (1986) and Hwa (1985). Here, *(latent) capacity utilization theory* is the underlying hypothesis. In the long run, producers are assumed to respond through change in potential output, or, in other words, through capacity creation. *Expected profitability theory*, following Chu and Morrison (1986)[4], and other supply inducing factors, such as capital formation and improved logistics, which many African exports identified as a major constraint (see Alemayehu and Edris, 2015) are believed to explain this.

Thus, the approach here essentially argues that the different factors emphasized by different authors are basically complementary and, hence, that these should explicitly be considered within any estimation. The lag structure should conceptually vary, depending on the nature of the commodity under consideration. For example, a longer lag structure should be used for beverages and minerals than for annual crops[5]. This can easily be handled by the lag length selection criteria employed in econometric approach employed. With this general overview, the export supply equation is determined by both demand and supply consideration as specified below, that begins with equation no [1],

$$X = A \left(\frac{e\,p_x}{p_d}\right)^{a_1} \left(e\,p_x\right)^{a_2} \left(\frac{\overline{e\,p_x}}{p_d}\right)^{a_3} Z \qquad [1a]$$

3 Indeed, most studies use output of a commodity instead of exports on the assumption that change in output is easily convertible to change in exports. Export supply models, on the other hand, employ exports for this purpose, on the assumption that change in exports result from change in output.

4 The expected profit indicator applied by Chu and Morrison (1986) is again used, with minor changes. This may also be interpreted as a price instability index, since it is computed as the deviation of current price from a moving average price (at a specified lag), which is assumed to show the long run average price.

5 See Bond (1987) for a discussion of the empirical validity of this argument.

The term in the bracket, eP_x/P_d, is the real exchange rate P_x and P_d being the export and domestic prices, respectively. In logarithmic form, this can be given us,

$$X^{ss}_{si} = a_0 + a_{1p}\frac{ep_x}{p_d} + a_2\frac{ep_x}{p_d}_t - k^{-1}\sum_{i=1}^{k}\frac{ep_x}{p_d}_{t-i} + a_3(Z) \qquad [1b]$$

Capacity utilization | Expected profit | Other: capital formation

Where:

X - Export supply; e - Exchange rate, Px - Export price of Uganda; Pd - domestic price; Z – Supply factors such as capital formation and logistic hurdles/development indicators; the term in bracket, [..], is the expected profit indicator - the deviation of current price from k years moving average, that is shortened below by Π.

The global demand for a commodity group has two components. First, a stock/inventory demand that is assumed to be determined by expected level of interest rate (i_w) and current prices (usually in the consuming developed countries and now increasingly in emerging economies). Agents in the global market are assumed to hold commodities as part of their portfolio diversification scheme. The other part of aggregate demand is a consumption demand, be it industrial or otherwise. The latter is believed to be determined by the level of income (and its growth) of the trading partners (Y_{TP}) [6]and by price of commodities (P_x) relative to domestic price (P_d). This aggregate demand, in log form, may be specified as (see Alemayehu, 2002):

$$\ln X^{dd} = b_0 + b_1 \ln Y_{TP} + b_2 \ln i_w + b_3 \ln\left(\frac{eP_x}{P_d}\right) \qquad [2]$$

$$Where: \; b_1 > 0; \; b_2 < 0 \; b_3 < 0$$

The equilibrium model may be arrived at by simultaneously estimating equations [1] and [2] under the assumption that,

$$X^{dd} = X^{ss} \qquad [3a]$$

A disequilibrium version of this model may be formulated by assuming a partial adjustment model, which is adapted from a similar earlier formulation, alongside the GK model (Houthakker and Taylor, 1970; Alemayehu, 2002). Thus, the change in exports are assumed to partially adjust to the gap between demand and actual flows in the previous period,

$$\Delta \ln X_t = \lambda\,[\ln X^{dd}_t - \ln X_{t-1}] \qquad [3b]$$

where λ is the coefficient of adjustment and is defined as $0<\lambda<1$, and Δ is a first difference operator representing change. Equation [4] states that the quantity of export adjusts to the condition of excess demand and that there is some degree of stickiness in the supply conditions. Substitution of equation [1] into [3b] yields the following estimable equation for export supply:

$$\ln X_t = \beta_0 + \beta_1 \ln Y_{TP} + \beta_2 \ln i_w + \beta_3 \ln\left(\frac{eP_x}{P_d}\right) - \ln\left(\frac{eP_x}{P_d}\right) + \beta_4 \Pi + \beta_5 Z + \beta_6 \ln X_{t-1} \qquad [4]$$

$$Where: \beta_0 = b_0\lambda \quad \beta_1 = b_1\lambda > 0 \; \beta_2 = b_2\lambda < 0 \; \beta_3 = b_3\lambda < 0 \; \beta_4 = -\lambda a_2 < 0 \; \beta_5 = -\lambda a_3 < 0 \; \beta_6 = 1-\lambda > 0$$

; Π the term in square bracket in X^{SS}

The ARDL estimation approach employed (discussed below) will take care of this adjustment process by allowing to explicitly model the equilibrium (error) correction process. Note that due to data limitation, the study was unable to control for the impact of world interest rates.

3.2 Import Demand Model and Import Price Elasticities

Imports are key ingredients of production activity in Africa. Their central role gave the concept of "import compression" in the African trade and macro literature in the decades before the year 2000 (see Alemayehu, 2002; Rattso, 1994; Ndulu, 1991, among others). It is still central for growth in Africa. This can be shown by depicting output as a constant elasticity of substitution (CES) function of value added and imports. Combined with price effect, this gives a scale variable and a price elasticity. For our scale variable we can use the growth of gross output (C, I, G and X) weighted by importance to total imports which is given in equation 5 by Zm. (see

6 Although the coefficient of this variable is likely to be positive, the possibility of a negative coefficient cannot be ruled out. Specifically, this may occur if an increase in trading partners income is associated with faster growth in domestic production than in consumption of importable (See Goldstein and Khan, 1978: 276 and the reference cited there).

Alemayehu and Addis, 2016).

$$Z_m \propto \left(\frac{C}{M}\right)^{m_c} \left(\frac{I}{M}\right)^{m_i} \left(\frac{G}{M}\right)^{m_g} \left(\frac{}{M}\right) X^{m_x} \quad [5]$$

Note that, by implication, z_m is proportional to a geometric average of the components of gross output, Z. In empirical import studies, it is often found that the elasticity of imports with respect to the scale variable z_m is larger than 1. With this, the demand for imports in a typical African country could be taken as a function of income and relative price, like a typical demand for commodities. In a typical African country, this income is the sum of domestically generated income (GDP) and external financial including, official development assistance or aid (AID), external borrowing, B, FDI and remittances, R, summarized as Zi. The import demand equation thus could be specified as:

$$M = \beta_0 + \beta_1 \frac{eP_m}{P_d} + \beta_2 Y + \beta_3 Z_i \quad [6]$$

Where Y is GDP*; P_d domestic price; Zi includes aid or official development assistance, net borrowing, FDI and Remittances.

Due to lack of quarterly data for the elements in Z, the study uses only GDP as a proxy for income. Since GDP is sum of C, G, I, X, less M yet M forms the dependent variable, its eminent to use GDP which is not adjusted for imports (GDP*). The price of imports equals the (exogenous) price of imports in foreign currency, P_M($), times the exchange rate (e), times 1 plus the import tariff rate.

The empirics of this need to take two factors. First, since GDP is sum of C, G, I, X, less M. The M need to be excluded and we should use GDP less Imports (GDP*). The price of imports equals the (exogenous) price of imports in foreign currency, P_M($), times the exchange rate (e), times 1 plus the import tariff rate., therefore the estimated import demand equation is given by;

$$LnM = \beta_0 + \beta_1 ln\{eP_m^*(1+t)\} + \beta_2 lnY \quad [7]$$

To generate elasticities for each of the 15 commodity categories (list of commodities presented in appendix 2; table 2.15), fifteen models were estimated using ARDL technique. The overall elasticity was derived using the average quantity and prices for the fifteen models.

4.0 ESTIMATION/ECONOMETRIC APPROACH

The traditional approach used in estimating supply functions of primary commodity exports has been criticized on methodological grounds. In particular, there does not appear to be a clear distinction between short-run and long-run elasticities. In addition, it has been acknowledged that the application of simple OLS using time series data is likely to produce spurious regression results (Charemza and Deadman, 1992; Mckay, *et al,* 1998; and Alemayehu *et al,* 2012). However, modern time series modelling techniques provide a better way of addressing these problems. Co-integration analysis can be used to avoid spurious regressions while at the same time providing a means of explicitly distinguishing between long-run and short-run elasticities and an adjustment coefficient through the error correction formulation. This technique is best suited for estimating the export supply and import demand equations specified above and is therefore adopted in this study.

The other difficulty lies in determining the (relative) price variable as a measure of competitiveness. Although most studies use real exchange rate (for example Alemayehu, 1999 and 2001; Mwega, 2002; Ndung'u and Ngugi, 1999; McKay *et al.,* 1998; and Branchi *et al.,* 1999) the difficulty lies in the choice of the deflator (for example consumer price index, input prices, etc.). Moreover, the definition of real exchange rate is complex and controversial both in theory and in practice. Real exchange rate, for instance has several definitions in economic literature.

The traditional approach defines the real exchange rate as the nominal exchange rate multiplied by the ratio of foreign to domestic price level. In this context, the real exchange rate is referred to as the purchasing power

parity (PPP) exchange rate. Real exchange rate has also been defined as the (domestic) relative price of tradable to non-tradable goods (Edwards, 1988. For intuitive reasons and data considerations, this study adopts the traditional definition of the exchange rate, commonly used as a measure of competitiveness of the tradable sectors of a country, under ceteris paribus conditions. The general real exchange rate (RER$K) is therefore computed as: eP*/Pd where e = the nominal exchange rate (shillings per foreign currency), p* = world price index (US wholesale price) and Pd = domestic price (consumer price index). Other studies such as Alemayehu (1999, 2002) goes a step further by defining real exchange rate using commodity-specific prices instead of general world prices of exports and imports in gauging primary commodity export supply and import demand.

The other difficulty lies in obtaining reliable data and quantifying the non-price variables as often acknowledged in the literature. Consequently, most econometric time series studies often fail to find robust estimated results for proxies of such variables. Also, given the length of the productive life of perennial crops, decisions about planting imply some kind of assumption on the level of prices decades ahead. This implies that the full impact of price policies on the producers' economic behavior can only be evaluated over quite a long period of time—data covering several decades. Therefore, data covering only few years (as is usually the case in most studies in Africa) may not reflect the true long-run price elasticities (Branchi *et al.,* 1999). Mckay *et al.* (1998) and Peterson (1979) argues that time series data is not best-suited to estimating long-run elasticities because only short-run, year to year, fluctuations are observed. Long-run elasticity estimates are likely to be small since farmers will respond strongly to price changes only if they are perceived to be permanent. This may partly explain why even the long-run elasticities from time series data are biased downwards. That notwithstanding, time series remains the most widely used approach for estimating supply response and import demand models and one can therefore argue that the long-run elasticities derived from time series econometrics analysis are a better measure of the long-run response.

Co-integration analysis in this study is carried out under Autoregressive distributed Lag (ARDL) model. The technique is preferred to other co-integration approaches (such as the Johansen and Angel Granger) due it the advantages it enjoys. First, the approach does not require all variables to integrated of order one, as is the case in Johansen. Secondly, produces unbiased estimates even in the presence of endogenous covariates (Harris & Sollis, 2003). Third, the method can be applied even when the variables have different optimal number of lags. The reduced form version of the ARDL model is given by;

$$\Delta Y_t = \beta_0 - \alpha[Y_{t-1} - \theta' X_{t-1}] + \sum_{i=1}^{p-1} \gamma_i \Delta Y_{t-i} + \sum_{i=0}^{q-1} \lambda_i' \Delta X_{t-i} + e_t \quad [8]$$

Where; $\boldsymbol{Y}$ is the dependent variable-in which case is the volume of exports for a given commodity expressed in logs; $\boldsymbol{X}$ is a vector of the explanatory variables inclusive of the variable of interest (relative price) and other control variables; is the coefficient of the speed of adjustment which measures the rate at which equilibrium is restored given short run deviations; $\boldsymbol{\theta}$ is a vector of long run elasticities while $\boldsymbol{\gamma}$ and $\boldsymbol{\lambda}$ are short run elasticities.

While using the ARDL approach, there is need to test for the existence of long run relationship using bounds test. Bounds test is a Wald test (F-statistic) that tests whether all the long run coefficients are statistically equal to zero. If the computed F-statistic exceeds the upper critical value, the null hypothesis is rejected indicating that the variables are co-integration. If the computed F-statistic is lower than the lower bound critical value, we fail to reject the null hypothesis, and conclude absence of co-integration.

5.0 DATA AND ESTIMATION RESULTS

5.1 Data and Estimated Results: Export Supply Elasticities

To estimate export supply elasticities, quarterly time series data stretching from 2006 to 2018 was used. Data for export volumes and values for the different commodities was obtained from Bank of Uganda. Based on the volumes and values, unit prices (expressed in US dollars) for the different commodities were estimated. The unit of measurement for the different commodities were harmonised by converting to tonnes. Therefore the unit price was expressed as US dollars per tonne. Domestic prices for the different commodities were obtained from Uganda Bureau of Statistics and government agencies like the Coffee Development Authority and the Cotton Development Authority. Nominal exchange rate was obtained from Bank of Uganda while Gross Fixed Capital Formation (GFCF) was obtained from World Development Indicator-World Bank data base. Note that due to lack of quarterly data for GFCF, the study relied on interpolated data[7].

To get GDP of trading partners, major export destinations were identified and quarterly GDP for the respective countries obtained from the International Monetary Fund (IMF) database. Due to significant differences in the volumes of exports to the different countries, a weighted average for the GDP of trading partners was used. The weights being the shares of exports to each of the trading partners, ensuring that the weights add up to one.

5.1.1 Preliminary analysis

Descriptive statistics for the data (appendix 1; table 1.1) show that; Out of the six commodities, coffee was the most exported commodity with an average of 825,179.5 tonnes per quarter, followed by maize and beans with an average of 47,025.4 and 19,828.8 tonnes respectively. The least exported commodity was simsim and cotton with average quarterly exports of only 3,938.9 and 4,516.1 tons respectively. Regarding the external prices, fish was the most expensive commodity with a unit price of US$ 5,937.1 per ton. Followed by cotton and simsim with quarterly average external prices of US$ 2,930.3 and US$ 1,526.581 per tonne respectively. Coffee, maize and beans were the least expensive commodities on the external market with quarterly average external prices of US$ 112.7, US$ 274.4 and US$ 419.8 per tonne. Regarding domestic prices, fish was the most expensive commodity on the domestic market with a quarterly domestic price of UGX 12,535,079 (US$ 3,450) per tonne, followed by coffee and cotton whose average domestic prices were UGX 5,273780 (US$ 1,450) and UGX 4,018,622 (US$ 1,100) per tonne. Beans were the cheapest commodity domestically with an average quarterly price of UGX 2,230,671 (US$ 612) per tonne.

It is notable from the results that there were significant quarterly variations in the volumes of exports, the external prices and the domestic prices of these export commodities as shown by the high values of the standard deviation which suggests that quarterly movements in export quantities could be partly induced by variations in prices.

The trend lines for export commodities (appendix 4) show that for the period under review, there has been an increase in the volumes of coffee and maize exported and this could partly be attributed to the low prices of these commodities on the external markets which boosted demand for these exports. On the other hand, the volume of fish exports show a declining trend which can be attributed to declining fish stock as a result of overfishing recently reported[8]. There was a sharp increase in the volume of beans exported between 2016q1 and 2018q1. The volume of simsim exports increased sharply between 2014q1 and 2016q1 and thereafter, there was declining trend until 2018q1 when it increased sharply again. These variations are partly as a result of variations in prices of these commodities on the external market.

7 Interpolation was carried using Eviews soft ware

8 Recently, UPDF was deployed to curtail on illegal fishing and boost fish stock for exports

Before estimating the time series models, we test for stationarity using Augmented Dickey Fuller (ADF) and the Phillips-Perron (PP) tests for unit root[9]. The results presented in table 1.2 (appendix 1.2) show that the data for export models comprises a mixture of both stationary and non-stationary variables. Given that every commodity model contains at least one non-stationary variable, Autoregressive Distributed Lag (ARDL) model is deemed appropriate for estimating the elasticities of interest. In the estimation, optimal lags are automatically selected using Akaike Information Criterion (AIC).

5.1.2 Bounds test and diagnostic tests for export supply models

As indicated earlier, validity of the ARDL results entirely relies on existence of valid long run relationship which is tested using the bounds test. The results of the test applied on the models under consideration show that there exists co-integration in all the models save for cotton (appendix 1; Tables 1.3 and 1.4). This is shown by the high F-statistics which are above the upper bounds of the critical values defined by Peseran and Shin (2001). Accordingly, we proceed to estimate the short run and long run elasticities.

In adherence with the time series properties, it's important to determine whether the estimated models satisfy certain diagnostic tests before proceeding to discuss the estimates. In this study, we tested for serial correlation (using Breusch Godfrey test), heteroscedasticity (using Breusch Pagan test), normality (using the Jarque-Bera test), omitted variables (using the Ramsey RESET test), and multicollinearity-using variance inflation factor (VIF). Results of these tests presented in table 1.7 (Appendix 1) show that all the estimated models do not suffer from serial correlation heteroscedasticity, omitted variable bias, or multicollinearity since the p-values are all greater than 0.05. The Jarque-Bera test shows that the residuals for all the models save for the overall model are normally distributed. Even though the Jarque-Bera test shows that the residuals of the overall model are not normally distributed, according to the central limit theorem, they are assumed to follow a normal distribution since the sample size is greater than 30. We therefore conclude that the estimated models satisfy all the diagnostic test.

5.1.3 Short run and Long run Export Supply elasticities

Results in table 1.6 (appendix 1) show that overall, there is a positive export supply elasticity which however is not significant. Such findings suggest that Uganda's export production is infinitely elastic with respect to relative prices. As such supply can increase or decrease without necessarily being influenced by prices. The insignificant elasticity could be attributed to supply bottle necks that hinder increase in exports when prices increase. In addition, the limited number of commodities could also be responsible for the insignificant results since the elasticity is estimated based on the average prices of the various commodities. Also the fact that we are using quantities exported as a measure of export supply, could also bias the outcome especially when equilibrium doesn't hold. In the analysis, we assumed that adjustment takes place within a one-quarter period. The methodology of ARDL does not allow us to control for the sluggish adjustment by introducing the lagged values of dependent variable as this would result into perfect multicollinearity. Therefore excess supply and demand may emerge and this could affect export quantities and prices. Commodity specific elasticities are discussed in the subsequent

Maize*;* results show that maize has a positive elasticity of supply which is slightly above one (appendix 1; table 1.5). The results show that for every one percent increase in the relative price of maize, supply for maize exports increases by about 1.145 percent in the short run and 1.275 percent in the long run, keeping other factors constant. Such results imply maize exporters in Uganda react proactively to changes in the maize prices in the export destinations.

Fish*;* results show that fish has a positive elasticity in the long run and a negative elasticity in the short run

9 See Gujarati (2004) for eloquent explanation about the importance of unit root tests in time series analysis

(appendix 1; table 1.5). While the short run elasticity is significant at 10 percent, the long run elasticity is not significant at all. The negative elasticity can be interpreted from export demand side to imply high sensitive of demand for fish exports. The results therefore suggest that increase in relative price of fish reduces its demand by about 0.66 percent. When the relative price of Uganda's fish exports increases, it's substituted with fish from other countries. This perhaps points to the poor quality of the fish exports which do not command inelastic demand in the foreign market.

Beans; in the long run, beans have a negative elasticity (appendix 1; table 1.5). The results suggest that increase in the relative prices for beans reduces demand leading to a fall in production for exports. This is expected since majority of Uganda's trading partners can easily substitute importation of beans with domestic production. In the short run, supply of beans has a negative but inelastic supply. The impact is however not instantaneous since it only becomes significant after two quarters. This time can be attributed to supply constraints mainly characterised by poor climatic conditions.

Simsim*;* the export supply of simsim has a positive elasticity in the long run and negative elasticity in the short run (appendix 1; table 1.5). The long run results suggest that exports for simsim increase by 0.81 percent for every one percent increase in the relative price. Such results signify inelastic response of simsim exports to changes in the prices which is largely attributed to supply side constraints. The negative elasiticity in the short run is due to fall in export demand arising from the increase in prices.

Cotton*;* in the long run, cotton exhibits negative elasticity of supply (appendix 1; table 1.6). This somehow contradicts the law of supply but expected since cotton is a primary product used as inputs in industries and can easily be substituted for other inputs. Our results point to an important role for relative prices in determining the world demand for Uganda's cotton exports which in turn affects supply of exports. In the short run, a positive and significant elasticity is observed after one quarter. Supply for cotton does not react instantaneously to changes in relative prices is not instantaneous.

Coffee*;* the supply of coffee for export from Uganda is not responsive to changes in relative prices (appendix 1; table 1.6). This is shown by the highly insignificant elasticities both in the short run and long run. This implies that even if prices increase, supply of coffee exports does not increase thus missing the opportunity of reaping from increasing prices. Conversely, when the relative price falls, the supply of coffee exports does not fall as expected leading to losses on the side of exporters. The responsiveness of coffee exports to price changes can be attributed to supply bottlenecks that hinder increase in production to respond to price increase, and poor storage facilities making it difficult to reduce supply in the face of price decline.

Among the control variables, gross fixed capital formation as a measure of investment is found to have a positive and statistically significant impact on exports in Uganda. Overall, one percent increase in the gross fixed capital formation results in 1.44 percent increase in export supply in the country. The results also show that exports respond positively to expected profits by increasing supply for exports both in the short run and long run. There are commodities such as maize (in the long run) and cotton (in the short run) where exporters respond negatively to changes in expected profits.

5.2 Data and Estimated Results: Import Demand Elasticities

Similar to export supply elasticities, import demand elasticities were estimated using quarterly time series data stretching from 2006q1 to 2018q4. Data for import volumes, import values, and tariffs was obtained from Uganda Revenue Authority (URA). Note that in the data import prices are not reported. Therefore unit values (in US$) were used as import prices. The unit values were computed by dividing import values (in US$) by import quantity (in Kilograms). Unlike previous studies such as Jones (2008), we control for the impact of income on demand for imports, thus providing income elasticity

as well[10]. GDP was used to proxy for income and was obtained from World Development Indicators. Since we are explaining imports, the GDP we used in the study is import adjusted. Sixteen models in total were estimated; one for overall elasticities and the others for fifteen individual commodities deemed to be among the major imports for the country. The analysis was carried out using 2-digit HS code.

5.2.1 Preliminary analysis

Before proceeding to estimate the long run and short run coefficients using ARDL technique (earlier discussed), preliminary analysis was carried out to determine the distribution and the stationarity properties of the data. Table 2.2 (appendix 2) presents the descriptive statistics while Table 2.3 (appendix 2) presents results of the unit root tests. Results show that out of the fifteen commodities, mineral fuels were the largest imports with an average of 350,000 tonnes per quarter, followed by cereals with quarterly average of 145,000 tonnes, and then iron and steel with quarterly average of 86,000 tonnes. The least imported commodities were cocoa and cocoa preparations and dairy products with a quarterly average of 207.2 tonnes and 821.6 tonnes respectively. In terms of unit value, industry machinery is the most expensive commodity imported with a quarterly average price of US$ 6.7 per kilogram, followed by aluminium and related articles, and cocoa and cocoa preparations each with quarterly average price of US$ 2.8 per kilogram. Least expensive commodities include cereals with quarterly average price of US$ 0.3 per kilogram, followed by wood and its articles with quarterly average price of US$ 0.4 per kilogram. From the results, it is notable that there exists significant quarterly variations in the volumes imported as show by the high values of standard deviation. On the other hand, the standard deviations for unit values depict minimal variations suggesting that quarterly movements in import quantities are not necessarily induced by variations in prices.

Regarding tax, motor vehicle and parts attracted the highest tax with an average of US$ 231.3 per kilogram, followed by industrial machinery with an average of US$ 149.8 per kilogram, and then oil and mineral fuels with an average tax of US$ 46.4 per kilogram. Cereals, inorganic chemicals, cocoa and wood attracted the least tax with an average of US$1.3 per kilogram (for Cereals and inorganic chemicals) and 1.5 US$ per kilogram (for cocoa and wood).

The trends for the different commodities (Appendix 3) show that for the period under review, there has been a general increase in volumes imported for almost all the commodities. However, in the most recent periods, the trends for some commodities has been reversed. For instance import for furniture and beddings started to decline from 2015q3. This declining trend could partly be attributed to the “Buy Uganda Build Uganda” policy which requires government Ministries, Departments and Agencies to purchase locally manufactured furniture. The increase in the unit price for furniture and beddings could also explain the decline in its imports. For cocoa, there was a decline in import volumes between 2014q4 and 2016q2. The trend however reversed to show an increase in the imports of cocoa and cocoa preparations. Note that trend lines presented in appendix 3 also give an impression that the series for quantity are non-stationary since most of them are trending upwards. Stationarity properties of the data series are however tested using unit root tests.

Results for the unit root tests presented in table 2.3 (appendix 2) show that log of tariff-inclusive prices for all commodities under consideration are stationary at levels (i.e integrated of order zero, I(0)). Except the log of quantities for commodities with codes of 84, 87, 4, 18, 44 and 70 (which are stationary at levels and therefore integrated of order 0), log of quantities for the rest of the commodities are stationary at first difference (integrated of order one i.e. I (1)). GDP is integrated of order zero as confirmed by both tests. Such mixture of I(0) and I(1) variables therefore warrants the use of ARDL to estimate long run and short run elasticities.

5.2.2 Bounds test and diagnostic tests for import demand models

As indicated in the section for export elasticities, it is mandatory to test for existence of level relationship

10 Quarterly data for GDP was not available for the study period and therefore annual data was interpolated to quarterly using Eviews

while using ARDL. The results of the bounds tests confirm existence of long run relationship in all the sixteen commodities (appendix 2; tables 2.8, 2.9, 2.10 and 2.11). The computed F-statistics for all the models are above the upper bound critical values suggesting rejection of the null hypothesis of "no level relationship". Such results therefore allow for estimation of short run and long run elasticities for the respective commodities.

After estimating the models, it is necessary to ascertain whether the models satisfies certain conditions for time series analysis. Results of diagnostic tests presented in appendix 2; tables 2.12, 2.13, 2.14 and 2.15 show that all the models do not suffer from serial correlation neither do they suffer from heteroskedasticity, since the p-values are all above 0.05. Variance Inflation Factor for the models also rejects the possibility of multicollinearity in the models. Regarding omitted variable test, Ramsey RESET test suggests that some models such as inorganic chemicals, iron and steel, dairy produce, and edible preparations have omitted variables. This could be attributed to a number of factors that influence import demand but could not be controlled for due to lack of data. Normality test also suggest that residues for some models are not normally distributed. However, using the central limit theorem, we assume the distribution tends to normal since the sample size sufficiently large.

5.2.3 Short run and Long run import demand elasticities

In ARDL analysis, speed of adjustment is of immense importance. As indicated earlier, it measures the rate at which short run deviations are corrected to restore long equilibrium. For all the sixteen models, the speed of adjustment is found to have reasonable magnitude and right sign (between -1 and 0). The speed of adjustment for the overall elasticity implies that about 96.8 percent of the short run deviations are corrected in one quarter[11]

Overall, our analysis reveals price inelastic import demand curve particularly in the long run. Increase in tariff-inclusive price results in less than proportionate decrease in quantity of imports demanded. Similarly, decrease in tariff-inclusive price results in less than proportionate increase in quantity of imports demanded. Results in table 2.4 (appendix 2) show that, every one percent increase in tariff inclusive price, import demand reduces by 0.97 percent in the long run and vice versa. The estimated long run elasticity is very close to that obtained by Jones (2008)[12]. The long run elasticity is not surprising given narrow range of substitutes. Such results also suggest that import surges from price and tariff reductions are less likely in the long run. In the short run however, the results are unexpected given that import demand is found to increase with increase in price. This could be explained by information asymmetry where demand may remain high in spite of the increase in prices since some consumers and traders may not immediately notice the increase in prices especially if the increment is through tariffs. The positive elasticities could also be explained by demand for goods of ostentation (such as mobile phones) where consumers associate the high price with the quality of the products. Note that the short run elasticity is significantly less than the long run elasticity in absolute terms, resulting in overall negative elasticity of -0.31. Regarding income, no significant elasticity is found in the long run implying demand for imports in the long run is not responsive to changes in income. Import demand is however highly responsive to income in the short run where one percent change in income leads to 1.3 percent increase in quantity demanded.

Commodity specific elasticities show that out of the fifteen commodities, cereals, iron and steel, diary produce, and glass and glassware are the only commodities with elastic demand in the long run. Implying increase in import prices results in more than proportionate decrease in quantity demanded of these commodities. The rest of the commodities have inelastic demand with respect to the prices. Some commodities such as paper and paperboard, inorganic chemicals, industrial machinery, motor vehicles and parts, and

11 Similar interpretation holds for all the other models

12 While using fixed effect estimator, Jones (2008) obtained import demand elasticity of 0.948

mineral fuels have import demand elasticities below -0.5 implying the demand for such products is highly inelastic with respect to the price changes. Such results are expected since most of these commodities are not produced locally and consumers only have the option of importing. Commodity specific elasticities are discussed in details in the sections below;

Inorganic chemicals; results in table 2.4 (appendix 2) show that demand for imports of inorganic chemical is highly inelastic with respect to price. For every one percent increase/decrease in price, quantity demand for these imports reduces/increases by only 0.23 percent in the long run. This implies the change in quantity demanded for the commodity is not commensurate to the change in price and tariffs. The results suggest that tariff reduction does not result in import surge while at the same time tariff increase is less likely to discourage importation of these commodities. Therefore slight increase in tariffs would result in more revenue collections. In the short run however, a positive elasticity is observed which could still be attributed to the reasons alluded to earlier. Analysis also shows that long run demand for inorganic chemical is income inelastic with elasticity of 0.65 while in the short run, demand for inorganic chemical is not responsive to changes in income.

Tanning and dyeing extracts; import demand for this sector is found to be relatively inelastic. Long run results in table 2.4 (appendix 2) show that one percent increase in the price and tariff results in 0.96 percent reduction in quantity demanded for the commodities. This implies that an increase/decrease in price and tariffs results in nearly proportionate decrease/ increase in quantity demanded of the products. This suggests that changes in tariffs and prices are less effective in influencing demand for these products. The short run elasticity is not significant suggesting that import demand is not responsive to tariff and price changes in the short run. The long run income elasticity is found to be negative but marginally significant. In the short run, zero lag was chosen for GDP and therefore no coefficient produced.

Wood and articles of wood; results indicate that imports of wood have inelastic demand in the long run (table 2.4; appendix 2). For every one percent increase in tariff and price, quantity demanded reduces by only 0.54 percent. This implies that tariff increases have minimal impact on quantity demanded while tariff reduction would not also induce import surges. In the short run, demand for wood imports is even more inelastic with one percent increase in price and tariff leading to only 0.29 percent reduction in quantity demanded and vice versa. The results also show that demand for wood and articles of wood is not responsive to changes in income.

Furniture and beddings; demand for imported furniture is also found to be fairly inelastic in the long run (table 2.5; appendix 2). One percent increase/decrease in price and tariff leads to 0.85 percent decrease/ increase in quantity demanded. Tariff liberalisation in this sector is unlikely to cause a surge in imports but slight reasonable increases in tariffs are associated with revenue gains in this sector. In the short run however, a positive elasticity (though of smaller magnitude) is observed in the sector. This could still be attributed to information asymmetry alluded to earlier. In absolute terms, the short run coefficient is less than the long run coefficient, resulting in a negative overall elasticity of -0.75. Changes in income are found not to significantly influence demand for furniture and beddings.

Cereals; these are found to have fairly elastic demand with respect with price, implying import of cereals is highly sensitive to prices in the long run (table 2.5; appendix 2). One percent increase/decrease in price and tariffs results in 1.4 percent decrease/increase in quantity demanded. This is expected given that cereals are agricultural products which can easily be substituted. The results imply that tariff reduction is likely to result in import surge thus affecting the country's trade balance. In the short run, results indicate that demand for imported cereals is not responsive to price and tariff changes since the elasticity is not significant. Income is found to have a significantly positive impact on demand for cereals imports both in the short run and long run with elasticities of 3.7 and 1.6 respectively.

Mineral fuels; the long run results indicate that demand for imports of minerals fuels is inelastic (table 2.5; appendix 2). An increase in prices and tariffs for these products results in less than proportionate decline in quantity demanded. One percent increase/decrease in price and tariff leads to 0.5 percent decrease/ increase in quantity demanded in the long run. This suggests that tariff changes have minimal impact on quantity demanded implying there are revenue gains associated with slight tariff increases. This also implies tariff liberation for this commodity is less likely to worsen balance of trade since there would be no import surge. In the short run, a positive elasticity is observed which is however significantly less than the long run elasticity in absolute terms leading to overall elasticity of -0.4. Regarding income, inelastic is obtained with one percent increase/decrease in income leading to 0.5 percent increase/decrease in demand in the long run.

Paper and paperboard; this is one of the commodities whose import demand is found to be highly inelastic in the long run (table 2.5; appendix 2). The results suggest that one percent increase in price and tariffs results in only 0.1 percent reduction in quantity demand and vice-versa. Therefore increasing tariffs of such commodities would leave the balance of trade nearly unchanged, while tariff increases would also have a dismal impact on quantity demanded. In the short run, a positive elasticity is obtained which almost cancels out the negative long run elasticity leading to perfectly inelastic demand overall. The long run demand for paper and paperboard is found to be inelastic with respect to income while in the short run, demand is found not to respond to changes in income.

Iron and steel; demand for iron and steel imports in Uganda is fairly elastic in the long run (table 2.6; appendix 2). Results show that, one percent increase in price and tariffs on iron and steel products results in 1.1 percent decline in the quantity demanded. This suggest tariff liberation/reduction is likely to lead to deterioration of the balance of trade account. At the same time, price and tariff increases are likely to discourage importation of such products. In the short run, again a positive elasticity is obtained, which however is relatively smaller than the long run elasticity leading to overall elasticity of -0.96. Demand for iron and steel imports is found to be inelastic with respect to changes in income. Long run results show that one percent increase/decrease in income induces 0.7 percent increase/decrease in demand for iron and steel imports.

Industrial machinery; in the long run demand for industrial machinery is found to be highly inelastic (table 2.6; appendix 2). Changes in price and tariff has minimal impact on quantity demanded of these commodities. Results suggest that one percent increases/decrease in price and tariff results in 0.26 percent decrease/increase in quantity demanded for these commodities. The short run instantaneous elasticity is found not to be significant suggesting that demand for imported industrial equipment is not price responsive.

Motor vehicles and parts; the long run demand for motor vehicles and related parts is also found to be highly inelastic (table 2.6; appendix 2). Results show that if price and tariffs increased by one percent, demand would reduce by only 0.33 percent and vice versa. The inelastic demand is expected given that these are products that are not domestically produced. In addition they are durable goods therefore increase or decrease in the price and tariff would have minimal impact on quantity demanded. In the short run, a positive coefficient is obtained which is however very small in magnitude, leading to negative overall elasticity. Our results also show that demand for motor vehicles and parts is not responsive to changes in income.

Cocoa and cocoa preparations; the findings show that demand for cocoa imports is inelastic with respect to price (table 2.6; appendix 2). One percent increase/ decrease in the price and tariff results in only 0.5 percent decrease/increase in quantity demanded in the long run. Price fall and tariff reduction are therefore less likely to result in import surges and deterioration of balance of trade. At the same time, tariff increases in the long run are less likely to discourage importation of

such commodities. In the short run, a positive elasticity is obtained which however is lower than the long run elasticity in absolute terms, resulting in a negative average elasticity between the short run and long run. Income is found to have minimal impact on the demand for cocoa and cocoa preparations which is marginally significant in the long run.

Dairy products; in the long run, demand for imported dairy products is found to be fairly elastic (table 2.7; appendix 2). Results suggest that one percent increase/ decrease in price and tariff for dairy products results in 1.18 percent decrease/increase in demand. Implying demand for imported dairy products is highly responsive to changes in prices and tariffs. This is highly expected given that Uganda is an agricultural economy that also produces dairy products making them substitutable. The results further imply that liberalisation of tariffs on dairy products is likely to result in deterioration of balance of trades due to import surges. Similar to cocoa, changes in income only marginally influence demand for dairy products in Uganda.

Glass and glassware; findings indicated that import of this category of commodities has fairly elastic demand in the long run (table 2.7; appendix 2). Specifically, a one percent increase/decrease in the price and tariff results in 1.23 percent decrease/increase in quantity demanded. This implies demand for glass and glassware in Uganda is highly price responsive and that smaller changes in price and tariff have bigger impacts on revenue and balance of trade depending on the direction of change. Price fall and tariff reduction would result in deterioration of trade balance while price and tariff increases would result in revenue loss. However in the short run, demand for import of glass and glassware is not responsive to changes in price and tariffs, but highly responsive to income with income elasticity of 2.7. Demand for glass and glassware only responds to income changes in the short run. Results show that demand for glass and glassware is highly income elastic with one percent increase/decrease in income leading to 2.7 percent increase/decrease in quantity demanded.

Edible preparations; in the long run, demand for imports of edible preparations is found to be fairly inelastic (table 2.7; appendix 2). Results suggest that demand for edible preparations is less sensitive to price and tariff changes, with one percent increase/decrease in prices and tariff leading to 0.51 percent reduction/ increase in quantity demanded for these imports. Therefore price and tariff fall or increase have minimal impact on quantity demanded for these commodities. The short run coefficient is found as positive, which however is less than the long run elasticity resulting in an average elasticity of -0.54. Demand for edible preparations only responds to income changes in the long run. The response is however inelastic given that one percent increase/decrease in income leads to only 0.49 percent increase/decrease in quantity demanded.

Aluminium and related articles; the long run results show that, demanded for imports of aluminium products is fairly inelastic (table 2.7; appendix 2). Results show that, one percent increase/decrease in price and tariff results in 0.65 percent reduction/ increase in quantity demanded of aluminium products. In the short run, a positive elasticity was obtained but the overall elasticity is negative since the negative long run elasticity outweighs the positive short run elasticity. Regarding income, results show that demand for aluminium is income inelastic in the long run and not responsive to income changes in the short run. One percent increase/decrease in long run income induces 0.9 percent increase/decrease in quantity demanded.

In summary, the study findings indicate that Uganda has inelastic demand for imported commodities in the long run. Changes in prices and tariffs induce less than proportionate change in quantity demanded. This suggests that tariff liberation has minimal impact on trade balance. At the same time, slight increase in tariffs are associated with revenue gains. However, the long run elasticities vary significant across specific commodity imports with some commodities having inelastic demand (inorganic chemicals, tanning and dyeing extracts, wood and articles of wood, furniture and beddings, mineral fuels, paper and paperboard, industrial machinery, motor vehicles and parts, cocoa

and cocoa preparations, edible preparations, and aluminium) while others have elastic demand (cereals, iron and steel, diary produce, and glass and glassware). For commodities with elastic demand, price and tariff changes have significant impact on revenue and balance of trade. For instance reducing tariffs for such commodities is most likely to worsen balance of trade due to surge in imports while increasing tariffs may instead lead to loss of revenue due to a fall in import volumes. Policy makers may therefore maintain tariffs at the existing levels.

6.0 CONCLUSION

This study was intended to provide evidence on the degree of responsiveness of quantity of exports supplied and quantity of imports demanded to changes in the respective prices. Both overall and commodity specific elasticities were estimated using Autoregressive distributed lag model based on quarterly data for the period 2006q1 to 2018q4. As per data availability, six exports commodities and fifteen import commodities were considered in the analysis. The overall model for supply elasticities shows that export supply in Uganda is not responsive to changes in relative prices both in the short run and long run. This could be attributed to supply constraints which limit increase in export supply when prices increase. Regarding individual commodities, considerable variations have been observed. For instance, supply of maize is fairly elastic both in the short run and long run while that for simsim is fairly inelastic in the long run. Supply of coffee exports is not responsive to changes in the relative prices both in the short run and the long run.

On the imports side, estimates show that Uganda's long run demand for imports is fairly inelastic (but close to unitary) with respect to tariff-inclusive price. Implying, increase/decrease in price results in less than proportionate decrease/increase in quantity demanded. Regarding individual commodities, mixed results have been found, commodities such as cereals, iron and steel, diary produce, and glass and glassware have fairly elastic demand while the others have inelastic demand in the long run. The short run results are equally mixed with some commodities exhibiting positive elasticity, which we largely attributed to demand for goods of ostentation and information asymmetry especially if the increase in price is through tariffs.

Estimated elasticities therefore present interesting policy implications. On the export side, there is need for measures to overcome supply rigidities to enable supply of exports respond to changes in relative prices positively. Measures to reduce cost of production such as investment in infrastructure, utilities (both power and water), and favorable tax policies are fundamental. In addition, there is need to create strong linkages between export oriented firms and sustainable sources of raw materials.

Regarding imports, commodity specific elasticities suggest that trade policies need to be carefully and selectively implemented. For instance tariff liberalization on commodities whose demand is elastic is likely to deteriorate balance of trade due to import surges while increase in tariffs for such commodities is likely to result in revenue loss. On the other hand, changes in tariffs and prices will have minimal impact on commodities with inelastic demand. Therefore depending on the objective of the policy, it is likely to be more effective on commodities with elastic demand than those with inelastic demand.

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APPENDIX 1: TABLES FOR EXPORT SUPPLY MODELS

Table 1.1: Descriptive Statistics

	Obn	Mean	Std Dev.	Maximum	Minimum
Volume for maize	52	47,025	30,194	137,460	11,492
Foreign price for maize	52	274	64	517	178
Domestic price for maize	52	3,512,690	1,274,718	5,587,985	1,164,571
Volume for fish	52	5,771.92	1,553	9,464	3,029
Foreign price for fish	52	5,937	1,277	8,118	3,865
Domestic price for fish	52	12,535,079	5,470,963	21,563,482	3,698,499
Volume for beans	52	19,828	24,824	95,367	1,398
Foreign price for beans	52	419.78	159	945	135
Domestic price for beans	52	2,230,671	711,783	3,611,321	893,254
Volume for Simsim	52	3,938	3,510	17,874	126
Foreign price for Simsim	52	1,526	1,985	13,965	546
Domestic price for Simsim	52	938,031	349721.5	1,922,546	331,942
Volume for cotton	52	4,516	4,761	20,895	138
Foreign price for cotton	52	2,930	3,199	17,553	897
Domestic price for cotton	52	4,018,622	1,846,601	9,115,876	1,787,537
Volume for coffee	52	825,179	193,502	1,212,472	457,061
Foreign price for coffee	52	112	18	156	82
Domestic price for coffee	52	5,273,780	1,610,123	8,586,579	2,790,860
Exchange rate	52	2,592	695	3,762	1,634
GFCF for Uganda	52	5,759	1,274	8,199	3,272
GDP for trading Partners	52	516,351	119,697	714,859	275,350

Note: (i) GFCF represents Gross Fixed Capital Formation; (ii) Domestic prices are expressed in Uganda shillings while foreign prices are expressed in US dollars; (ii) GFCF and GDP are measured in millions of US$

Table 1.2: Unit root tests

	Level		First difference		
Variable	**ADF statistic**	**PP statistic**	**ADF statistic**	**PP statistic**	**Order**
LnVolume_Maize	-3.131**	-3.045**			I(0)
LnRelative_Price_Maize	-4.109***	-4.010**			I(0)
LnExpected Profit_Maize	-5.142***	-5.026***			I(0)
LnVolume_Beans	-1.718	2.547	-10.784***	-12.006***	I(1)
LnRelative Price_Beans	-5.879***	-5.842***			I(0)
LnExpected Profit_Beans	-6.456***	-6.669***			I(0)
LnVolume_Fish	-3.244**	-3.037**			I(0)
LnRelative Price_Fish	-4.381***	-4.295***			I(0)
LnExpected Profit_Fish	-5.069***	-5.070***			I(0)
LnVolume_Simsim	-2.267	-5.282***	-10.879***	-15.673***	I(1)
LnRelative Price_Simsim	-4.626***	3.837***			I(0)
LnExpected Profit_Simsim	-5.742***	-2.811*			I(0)
LnVolume_Cotton	-4.529***	-4.488***			I(0)
LnRelative Price_Cotton	-4.460***	-4.320***			I(0)
LnExpected Profit_Cotton	-3.664***	-3.663***			I(0)
LnVolume_Coffee	-3.370**	-3.211**			I(0)
LnRelative Price_Coffee	-3.637***	-3.776***			I(0)
LnExpected Profit_Coffee	-3.969***	-3.635***			I(0)
LnGDP_TP	-1.708	-1.803	-2.971**	-4.249***	I(1)
LnGFCF_Uganda	-1.744	-2.276	-4.116***	-3.890***	I(1)

Table 1.3: Bounds test

	Simsim	**Maize**	**Fish**	**Coffee**
F-STAT	14.03	7.88	4.08	5.47
10% (L.B, U.B)	2.45,3.52	2.45, 3.52	2.45, 3.52	2.45, 3.52
5% (L.B, U.B)	2.86, 4.01	2.86, 4.01	2.86, 4.01	2.86, 4.01
1% (L.B, U.B)	3.74, 5.06	3.74, 5.06	3.74, 5.06	3.74, 5.06

Table 1.4: Bounds test (continued)

	Cotton	**Beans**	**Overall**
F-STAT	3.39	4.19	5.36
10% (L.B, U.B)	2.45, 3.52	2.45, 3.52	2.45, 3.52
5% (L.B, U.B)	2.86, 4.01	2.86, 4.01	2.86, 4.01
1% (L.B, U.B)	3.74, 5.06	3.74, 5.06	3.74, 5.06

Table 1.5: Short run and Long run results

Variables	Maize	Fish	Beans	Simsim
Long Run				
Ln(epx/pd)	1.275*** (0.308)	0.087 (0.476)	-2.997*** (1.034)	0.808** (0.312)
LnGFCF	1.771*** (0.451)	-0.360 (0.399)	3.328*** (0.903)	1.658*** (0.548)
LnGDP_TP	0.616 (0.347)	-0.070 (0.288)	1.296 (0.902)	0.691 (0.507)
Lnexpected_profits	-6.093*** (1.462)	0.192 (0.527)	-4.113 (3.205)	0.366 (0.220)
Speed of adjustment	**-0.898*** **(0.123)**	**-0.487*** **(0.141)**	**-0.494*** **(0.120)**	**-0.426*** **(0.179)**
Short Run				
D.Ln(epx/pd)	1.145*** (0.325)	-0.664* (0.373)	-0.147 (0.735)	-1.986*** (0.457)
LD.Ln(epx/pd)			0.184	
			(0.294)	
L2D.Ln(epx/pd)			0.754***	
			(0.228)	
D.lnGFCF	1.591*** (0.477)	-0.175 (0.195)	1.645*** (0.475)	2.364*** (0.835)
D.lnGDP TP	-0.554* (0.315)	-0.601** (0.287)	0.641 (0.488)	0.985 (0.732)
D.Lnexpected_profits	-5.473*** (1.426)	0.093 (0.244)	-2.033 (1.488)	2.195*** (0.566)
Constant	-10.859*** (2.671)	12.608*** (2.643)	-38.845*** (8.873)	-17.382 (4.752)

*Notes: (i) Standard errors in parentheses; (ii) * p < 0.10, ** p < 0.05, *** p < 0.01; (iii) Optimal lags were automatically selected using Akaike Information criterion (AIC)*

Table 1.6: Short run and Long run results (Continued)

Variables	Cotton	Coffee	Overall
Long Run			
Ln(epx/pd)	-1.384*** (0.387)	0.191 (0.520)	**0.006** **(0.129)**
LnGFCF	2.423* (1.273)	0.697*** (0.226)	**1.439***** **(0.117)**
LnGDP_TP	-1.863* (1.082)	0.005 (0.237)	**-0.226** **(0.107)**
Lnexpected_profits	0.264 (0.485)	0.100 (0.616)	**0.214***** **(0.068)**
Speed of adjustment	**-0.758***** **(0.189)**	**-0.717***** **(0.135)**	**-0.599***** **(0.117)**
Short Run			
D.Ln(epx/pd)	-0.450 (0.305)	0.137 (0.383)	**0.004** **(0.077)**
LD.Ln(epx/pd)	0.859*** (0.228)		
D.lnGFCF	1.836* (1.032)	0.500** (0.198)	**0.862***** **(0.183)**
D.lnGDP TP	-1.411* (0.825)	0.004 (0.170)	**-0.135**** **(0.067)**
D.Lnexpected_profits	-0.518** (0.245)	0.072 (0.440)	**0.128***** **(0.040)**
Constant	11.521 (10.504)	8.064*** (2.661)	**-3.361***** **(1.020)**

*Notes: (i) Standard errors in parentheses; (ii) * p < 0.10, ** p < 0.05, *** p < 0.01; (iii) Optimal lags were automatically selected using Akaike Information criterion (AIC)*

Table 1.7: Diagnostic test (p-values for the test)

	Simsim	Maize	Fish	Coffee	Cotton	Beans	Overall
Serial correlation	0.300	0.519	0.166	0.717	0.196	0.566	0.138
Heteroscedasticity	0.969	0.539	0.541	0.904	0.891	0.463	0.314
Normality	0.836	0.511	0.465	0.469	0.336	0.630	0.001
Omitted Variable	0.105	0.193	0.830	0.474	0.572	0.132	0.154
VIF	4.427	3.477	6.998	3.376	4.926	5.621	6.562

APPENDIX 2: TABLES FOR IMPORT DEMAND MODELS

Table 2.1: List of Import commodities considered in the analysis

Hscode	Commodity
04	Dairy products
10	Cereals
18	Cocoa and cocoa preparations
21	Edible preparations
27	Oils and Mineral fuels
28	Inorganic chemicals
32	Tanning and dyeing extracts
44	Wood and articles of wood
48	Pape and paperboard
70	Glass and glassware
72	Iron and steel
76	Aluminum and related articles
84	Industrial Machinery
87	Motor vehicles and parts
94	Furniture and beddings

Table 2.2: Descriptive statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
Quantity_28	52	1.81e+07	5.626e+06	6.320e+06	3.050e+07
Quantity_32	52	3.010e+06	1.559e+06	624,000.000	7.856e+06
Quantity_44	52	4.462e+06	1.831e+06	1.450e+06	1.090e+07
Quantity_94	52	5.570e+06	2.035e+06	1.660e+06	9.337e+06
Quantity_10	52	1.450e+08	4.760e+07	6.460e+07	2.920e+08
Quantity_27	52	3.500e+08	8.460e+07	1.420e+08	5.380e+08
Quantity_48	52	2.790e+07	7.605e+06	9.115e+06	4.370e+07
Quantity_72	52	8.600e+07	3.890e+07	3.890e+07	2.590e+08
Quantity_84	52	2.060e+07	1.310e+07	4.402e+06	1.030e+08
Quantity_87	52	4.620e+07	4.690e+07	1.260e+07	3.270e+08
Quantity_18	52	207,222.000	78,031.000	73,083.000	495,000.000
Quantity_4	52	821,578.000	850,008.000	108,925.000	5.333e+06
Quantity_70	52	1.060e+07	3.413e+06	5.300e+06	2.060e+07
Quantity_21	52	2.831e+06	1.179e+06	814000	7.716e+06
Quantity_76	52	2.363e+06	929469	666000	5.116e+06
Price_28	52	0.448	0.062	0.347	0.630
Price_32	52	1.832	0.267	0.909	2.580
Price_44	52	0.422	0.133	0.118	0.745
Price_94	52	1.927	0.463	1.258	3.233
Price_10	52	0.345	0.057	0.231	0.456
Price_27	52	0.791	0.293	0.443	2.390
Price_48	52	0.968	0.120	0.581	1.240
Price_72	52	0.754	0.176	0.318	1.200
Price_84	52	6.653	1.711	0.952	10.900
Price_87	52	2.728	1.533	0.236	12.400
Price_18	52	2.765	0.874	1.054	5.420
Price_4	52	1.721	1.062	0.324	6.171
Price_70	52	0.543	0.076	0.320	0.683
Price_21	52	1.850	0.472	0.941	3.425
Price_76	52	2.760	0.495	1.314	3.762
Tax_28	52	1.301	8.810	0.063	63.610
Tax_32	52	6.844	46.240	0.228	333.800
Tax_44	52	1.536	10.100	0.053	72.970
Tax_94	52	23.390	164.700	0.364	1,188.000
Tax_10	52	1.295	9.036	0.0089	65.200
Tax_27	52	46.430	332.800	0.208	2,400.00
Tax_48	52	11.350	80.190	0.135	578.500
Tax_72	52	2.832	19.400	0.061	140.100
Tax_84	52	149.800	1,074.000	0.150	7,748.00
Tax_87	52	231.300	1,661.000	0.102	11,976.000
Tax_18	52	1.512	3.864	0.417	28.760
Tax_4	52	2.297	13.020	0.092	94.370
Tax_70	52	2.814	19.200	0.074	138.600
Tax_21	52	4.043	25.920	0.231	187.300
Tax_76	52	9.835	65.930	0.265	476.100
GDP	52	7.670e+09	1.230e+09	5.720e+09	1.000e+10

Note: (i) Quantities are measured in kilograms; (ii)prices are measured in $US; (iii) tax is measured in $US per kilogram; (iv) The numbers attached to variables represent the HS Codes for the commodities presented in table 2.1

Table 2.3: Unit root tests

Variable	Level		First difference		
	ADF statistic	PP statistic	ADF statistic	PP statistic	Order
LnQuantity_10	-1.609	-2.634*	-7.375***	-13.262***	I(1)
LnPrice_10	-5.447***	-7.545***			I(0)
LnQuantity_27	-1.638	-1.953	-9.518***	-24.101***	I(1)
LnPrice_27	-4.995***	-6.950***			I(0)
LnQuantity_48	-1.369	-1.834	-6.605***	-15.386***	I(1)
LnPrice_48	-5.353***	-7.062***			I(0)
LnQuantity_72	-1.688	-2.178	-9.021***	-14.490***	I(1)
LnPrice_72	-4.590***	-6.836***			I(0)
LnQuantity_84	-3.129**	-4.183***			I(0)
LnPrice_84	-5.678***	-6.854***			I(0)
LnQuantity_87	-4.437***	-4.268***			I(0)
LnPrice_87	-4.742***	-6.518***			I(0)
LnQuantity_4	-3.381**	-3.692***			I(0)
LnPrice_4	-3.369**	-5.028***			I(0)
LnQuantity_18	-3.156**	-5.137***			I(0)
LnPrice_18	-4.741***	-6.682***			I(0)
LnQuantity_21	-1.374	-1.788	-8.079 ***	-11.395***	I(1)
LnPrice_21	-6.233***	-7.965***			I(0)
LnQuantity_28	-1.272	-1.992	-10.182 ***	-20.716***	I(1)
LnPrice_28	-5.419***	-7.429***			I(0)
LnQuantity_32	-1.513	-1.653	-7.005***	-12.842***	I(1)
LnPrice_32	-4.468***	-6.945***			I(0)
LnQuantity_44	-3.940***	-4.304***			I(0)
LnPrice_44	-3.584***	-5.522***			I(0)
LnQuantity_70	-3.186**	-5.894***			I(0)
LnPrice_70	-5.202***	-7.490***			I(0)
LnQuantity_76	-2.083	-2.696*	-6.697***	-13.609 ***	I(1)
LnPrice_76	-4.239***	-6.684***			I(0)
LnQuantity_94	-2.218	-2.704*	-7.670***	-12.322***	I(1)
LnPrice_94	-4.199 ***	-6.663***			I(0)
Lngdp3_imp	-2.859*	-4.767***			I(0)

Note: (i) The numbers attached to variables represent the HS codes for the commodities; *p<0.1, **p<0.05, ***p<0.01

Table 2.4: Short run and Long run elasticities

Variables	Overall Import demand elasticity	Inorganic chemicals (28)	Tanning and dyeing extracts (32)	Wood and articles of wood (44)
Long Run				
LnP(1+t)	**-0.974*** (0.142)**	-0.232** (0.112)	-0.963*** (0.283)	-0.541** (0.259)
LnGDP	**0.179 (0.108)**	0.648*** (0.264)	-0.485* (0.255)	0.054 (0.306)
Speed of adjustment	**-0.968*** (0.147)**	**-0.519 *** (0.119)**	**-0.607*** (0.109)**	**-0.584*** (0.134)**
Short Run				
D.LnQnty	**0.186**		-0.165*	
	(0.102)		(0.093)	
D.LnP(1+t)	**0.661** (0.266)**	0.135*** (0.030)	0.861 (0.939)	-0.288* (0.160)
LD.LnP(1+t)	**0.768*** **		-2.048*	
	(0.215)		(1.019)	
L2D.LnP(1+t)	**0.551*** **		1.535	
	(0.175)		(1.032)	
D.LnGDP	**1.313** (0.476)**	-0.591 (0.954)		
Constant	**3.122*** (1.034)**	1.003 (2.104)	0.483*** (0.101)	8.017* (4.238)

*Notes: (i) Standard errors in parentheses; (ii) * p < 0.10, ** p < 0.05, *** p < 0.01; (iii) Optimal lags were automatically selected using Akaike Information criterion (AIC); (iv) where there is no short run coefficient, it means zero lag was chosen for the variable*

Table 2.5: Short run and Long run elasticities (continued)

Variables	Furniture and beddings (94)	Cereals (10)	Mineral fuels (27)	Paper and paperboard (48)
Long Run				
LnP(1+t)	-0.846*** (0.259)	-1.399*** (0.401)	-0.463*** (0.140)	-0.101*** (0.054)
LnGDP	-0.387 (0.234)	1.578*** (0.252)	0.523*** (0.131)	0.825*** (0.120)
Speed of adjustment	**-0.511*** **(0.120)**	**-0.561*** **(0.121)**	**-0.424*** **(0.125)**	**-0.659*** **(0.105)**
Short Run				
LD.LnQnty		-0.261**	-0.378***	
		(0.116)	(0.123)	
D.LnP(1+t)	0.101 *** (0.025)	-0.014 (0.068)	0.069*** (0.011)	0.107*** (0.021)
LD.LnP(1+t)		-0.078		
		(0.051)		
L2D.LnP(1+t)		-0.068**		
		(0.033)		
D.LnGDP		3.665*** (1.125)		0.371 (0.818)
Constant	4.869** (2.601)	-10.354*** (2.873)	3.346*** (1.065)	-1.013 (1.823)

*Notes: (i) Standard errors in parentheses; (ii) * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$; (iii) Optimal lags were automatically selected using Akaike Information criterion (AIC); (iv) where there is no short run coefficient, it means zero lag was chosen for the variable*

Table 2.6: Short run and Long run elasticities (continued)

Variables	Iron and Steel (72)	Industrial machinery (84)	Motor vehicles and parts (87)	Cocoa and cocoa preparations (18)
Long Run				
LnP(1+t)	-1.115*** (0.174)	-0.269*** (0.092)	-0.325*** (0.091)	-0.503* (0.252)
LnGDP	0.696*** (0.161)	0.681*** (0.206)	0.299 (0.363)	0.451* (0.237)
Speed of adjustment	**-0.869*** (0.115)**	**-0.922*** (0.178)**	**-0.786*** (0.136)**	**-0.825*** (0.132)**
Short Run				
LD.LnQnty		-0.032		
		(0.138)		
D.LnP(1+t)	0.152*** (0.063)	0.044 (0.038)	0.117** (0.055)	0.473*** (0.121)
LD.LnP(1+t)	0.054	0.133***		
	(0.039)	(0.049)		
D.LnGDP	2.085 (1.377)	-1.225*** (0.331)	2.253 (3.056)	1.322 (2.054)
Constant	1.972 (3.162)	1.741 (4.318)	8.699 (6.522)	2.167 (4.517)

*Notes: (i) Standard errors in parentheses; (ii) * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$; (iii) Optimal lags were automatically selected using Akaike Information criterion (AIC); (iv) where there is no short run coefficient, it means zero lag was chosen for the variable*

Table 2.7: Short run and Long run elasticities (continued)

Variables	Dairy products (4)	Glass and glassware (70)	Edible preparations (21)	Aluminium and related articles (76)
Long Run				
LnP(1+t)	-1.182*** (0.122)	-1.227*** (0.257)	-0.507* (0.271)	-0.652*** (0.159)
LnGDP	0.921* (0.526)	-0.061 (0.155)	0.494** (0.191)	0.899*** (0.157)
Speed of adjustment	-0.929*** (0.098)	-0.968*** (0.150)	-0.764*** (0.137)	-0.972*** (0.123)
Short Run				
LD.LnQnty		-0.032		
		(0.138)		
D.LnP(1+t)		-0.063 (0.282)	0.091** (0.045)	0.109** (0.043)
LD.LnP(1+t)		0.085		
		(0.076)		
D.LnGDP	4.824** (2.334)	2.714*** (1.130)	0.134 (0.471)	1.179 (1.674)
LD.LnGDP				-3.966**
				(1.635)
Constant	13.051*** (1.362)	0.875 (3.391)	-8.239** (3.379)	-4.734 (3.568)

*Notes: (i) Standard errors in parentheses; (ii) * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$; (iii) Optimal lags were automatically selected using Akaike Information criterion (AIC); (iv) where there is no short run coefficient, it means zero lag was chosen for the variable*

Table 2.8: Bounds test

	Overall model	Inorganic chemicals (28)	Tanning and dyeing extracts (32)	Wood and articles of wood (44)
F-STAT	**17.22**	10.71	22.49	6.30
10% (L.B, U.B)	**(3.17, 4.14)**	(3.17, 4.14)	(3.17, 4.14)	(3.17, 4.14)
5% (L.B, U.B)	**(3.79, 4.85)**	(3.79, 4.85)	(3.79, 4.85)	(3.79, 4.85)
1% (L.B, U.B)	**(5.15, 6.36)**	(5.15, 6.36)	(5.15, 6.36)	(5.15, 6.36)

Table 2.9: Bounds test (continued)

	Furniture and beddings (94)	Cereals (10)	Mineral fuels (27)	Paper and paperboard (48)
F-STAT	6.83	11.42	7.03	17.42
10% (L.B, U.B)	(3.17, 4.14)	(3.17, 4.14)	(3.17, 4.14)	(3.17, 4.14)
5% (L.B, U.B)	(3.79, 4.85)	(3.79, 4.85)	(3.79, 4.85)	(3.79, 4.85)
1% (L.B, U.B)	(5.15, 6.36)	(5.15, 6.36)	(5.15, 6.36)	(5.15, 6.36)

Table 2.10: Bounds test (continued)

	Iron and Steel (72)	Industrial machinery (84)	Motor vehicles and parts (87)	Cocoa and cocoa preparations (18)
F-STAT	20.24	12.08	11.37	17.28
10% (L.B, U.B)	(3.17, 4.14)	(3.17, 4.14)	(3.17, 4.14)	(3.17, 4.14)
5% (L.B, U.B)	(3.79, 4.85)	(3.79, 4.85)	(3.79, 4.85)	(3.79, 4.85)
1% (L.B, U.B)	(5.15, 6.36)	(5.15, 6.36)	(5.15, 6.36)	(5.15, 6.36)

Table 2.11: Bounds test (continued)

	Diary produce (4)	Glass and glassware (70)	Edible preparations (21)	Aluminium and related articles (76)
F-STAT	32.93	13.99	11.95	22.17
10% (L.B, U.B)	(3.17, 4.14)	(3.17, 4.14)	(3.17, 4.14)	(3.17, 4.14)
5% (L.B, U.B)	(3.79, 4.85)	(3.79, 4.85)	(3.79, 4.85)	(3.79, 4.85)
1% (L.B, U.B)	(5.15, 6.36)	(5.15, 6.36)	(5.15, 6.36)	(5.15, 6.36)

Table 2.12: Diagnostic test (p-values for the test)

	Overall model	Inorganic chemicals (28)	Tanning and dyeing extracts (32)	Wood and articles of wood (44)
Serial correlation	**0.545**	0.784	0.524	0.522
Heteroscedasticity	**0.992**	0.411	0.957	0.442
Omitted Variable	**0.678**	0.007	0.174	0.123
VIF	**3.550**	3.080	2.040	1.870
Normality	**0.000**	0.762	0.453	0.000

Table 2.13: Diagnostic test (p-values for the test)-continued

	Furniture and beddings (94)	Cereals (10)	Mineral fuels (27)	Paper and paperboard (48)
Serial correlation	0.241	0.299	0.476	0.603
Heteroscedasticity	0.761	0.797	0.970	0.949
Omitted Variable	0.969	0.796	0.922	0.459
VIF	1.570	3.260	3.770	2.890
Normality	0.000	0.220	0.968	0.635

Table 2.14: Diagnostic test (p-values for the test)-continued

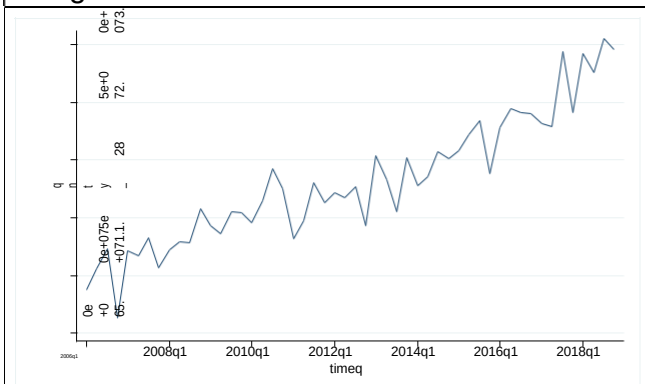
	Iron and Steel (72)	Industrial machinery (84)	Motor vehicles and parts (87)	Cocoa and cocoa preparations (18)
Serial correlation	0.682	0.448	0.597	0.138
Heteroscedasticity	0.139	0.429	0.579	0.204
Omitted Variable	0.069	0.203	0.831	0.866
VIF	2.850	2.490	1.990	2.160
Normality	0.000	0.000	0.000	0.837

Table 2.15: Diagnostic test (p-values for the test)-continued

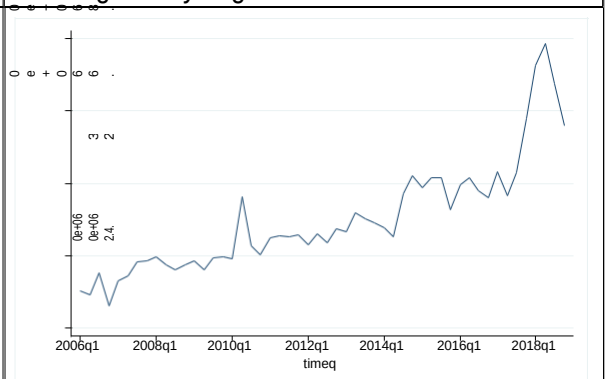
	Diary produce (4)	Industrial machinery (84)	Edible preparations (21)	Aluminium and related articles (76)
Serial correlation	0.318	0.967	0.341	0.850
Heteroscedasticity	0.539	0.644	0.539	0.743
Omitted Variable	0.039	0.589	0.015	0.589
VIF	1.360	4.460	1.610	2.180
Normality	0.000	0.008	0.000	0.570

Appendix 3: Trend lines for imported commodities

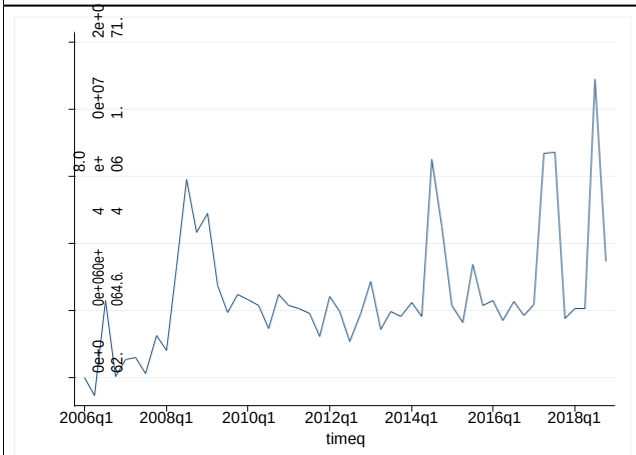
Inorganic chemicals



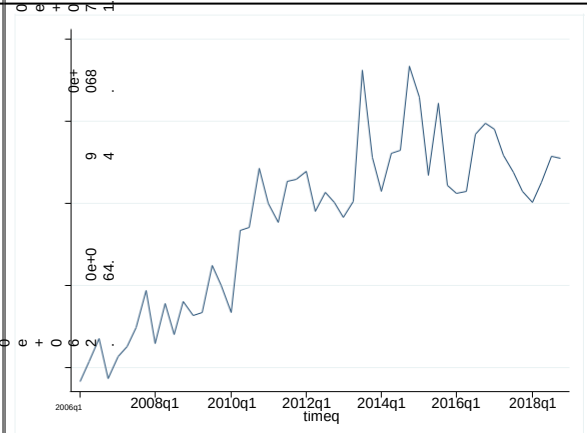
Tanning and dyeing extracts



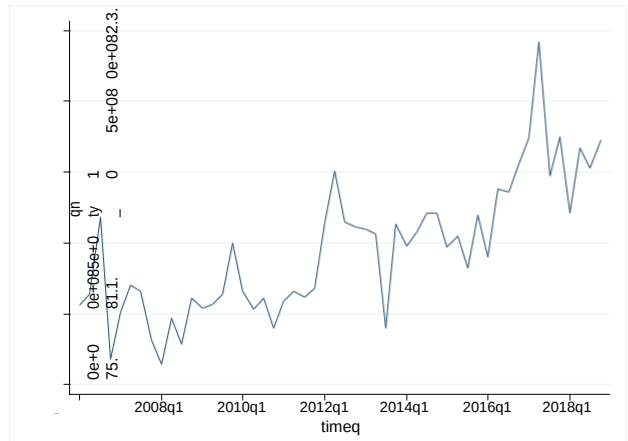
Wood and Articles of Wood



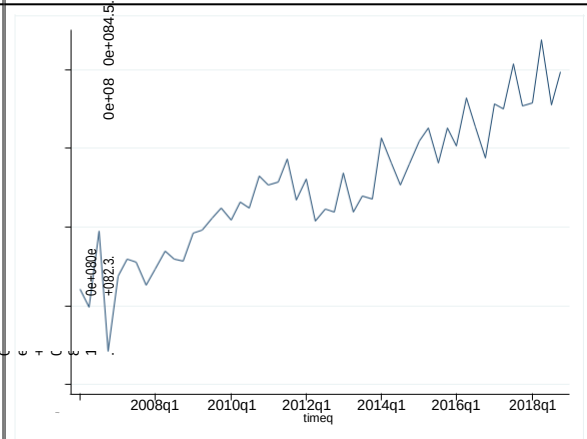
Furniture and Beddings



Cereals

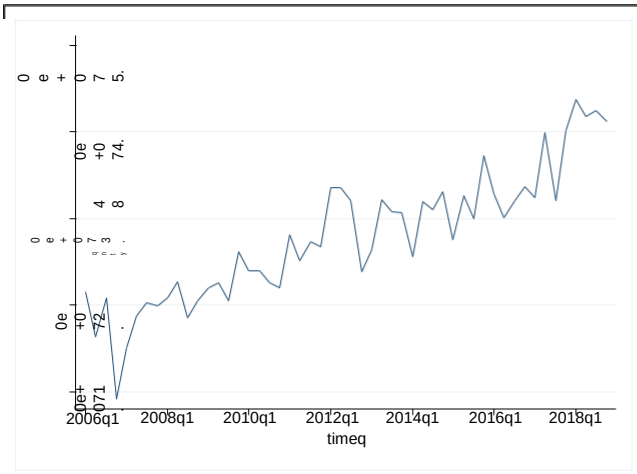


Oil and Mineral fuels

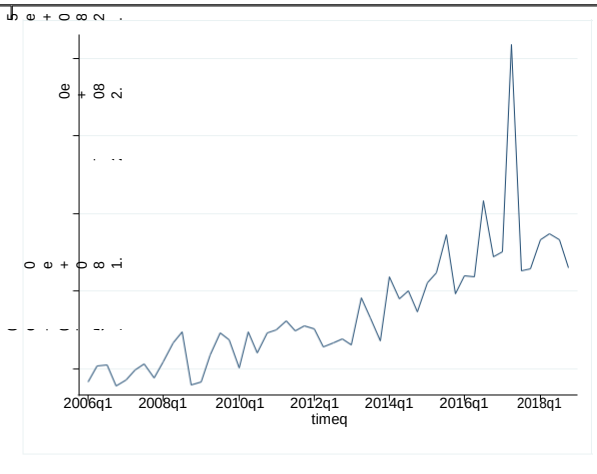


Paper and Paperboard

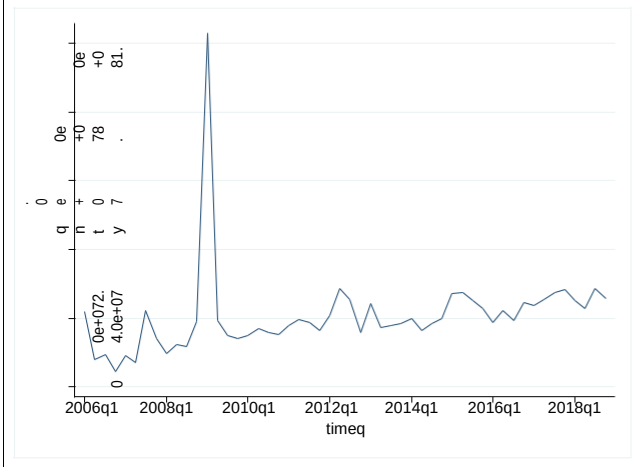
Iron and Steel



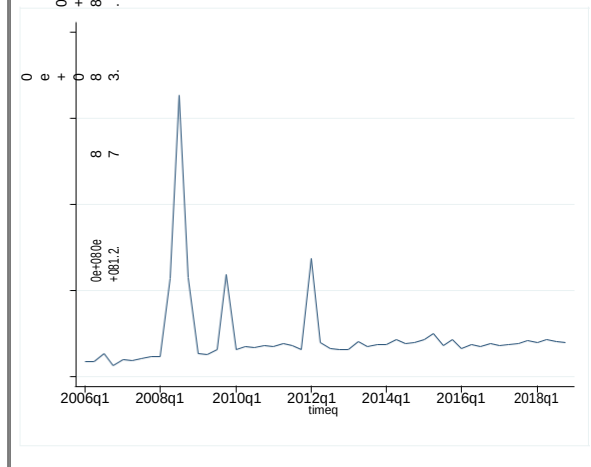
Industrial Machinery



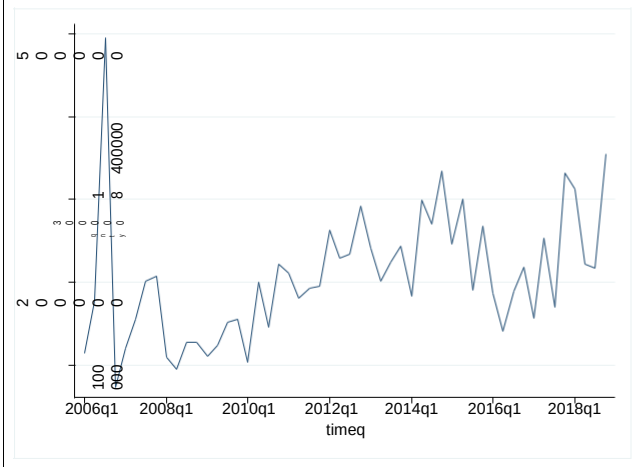
Motor vehicles and parts



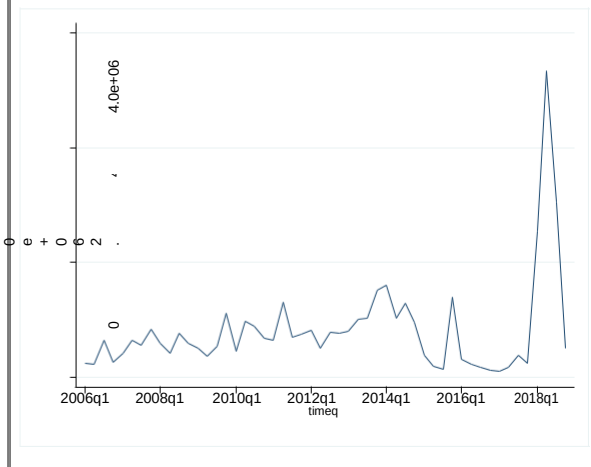
Cocoa and cocoa preparations



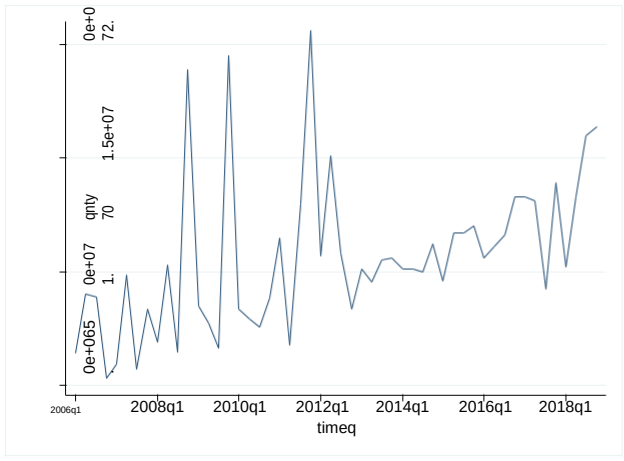
Dairy products

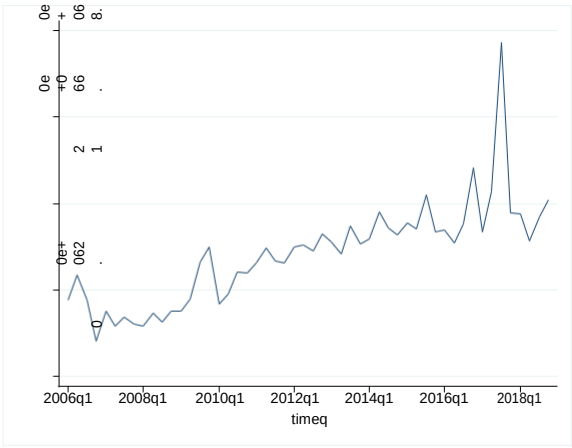


Glass and Glassware

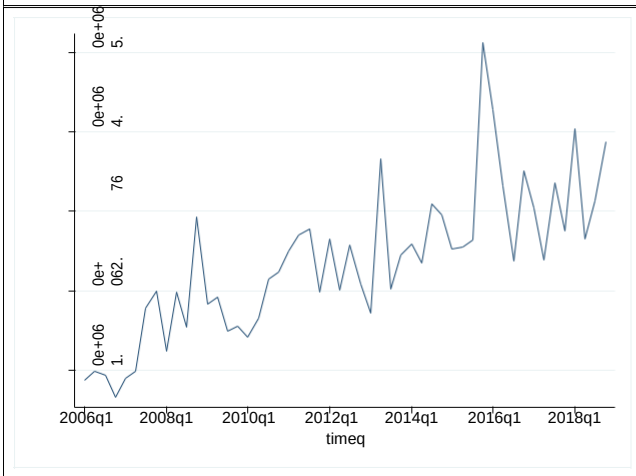


Edible preparations



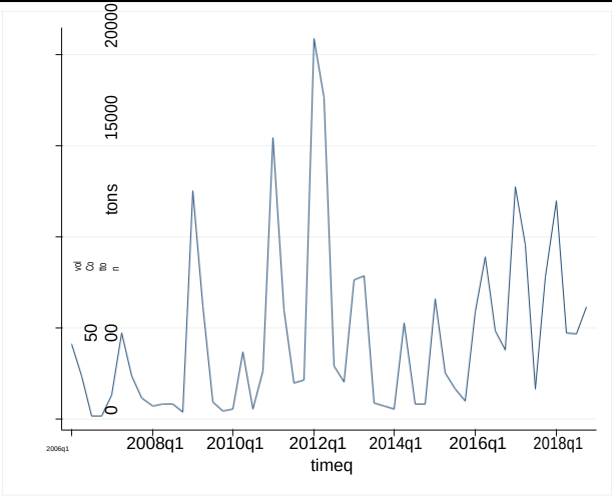


Aluminium and related articles

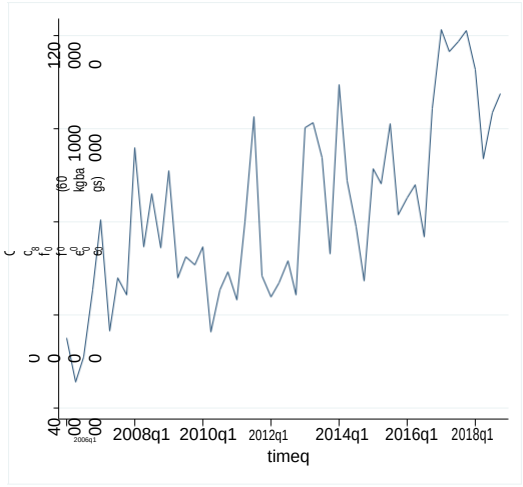


Appendix 4: trend lines for export commodities

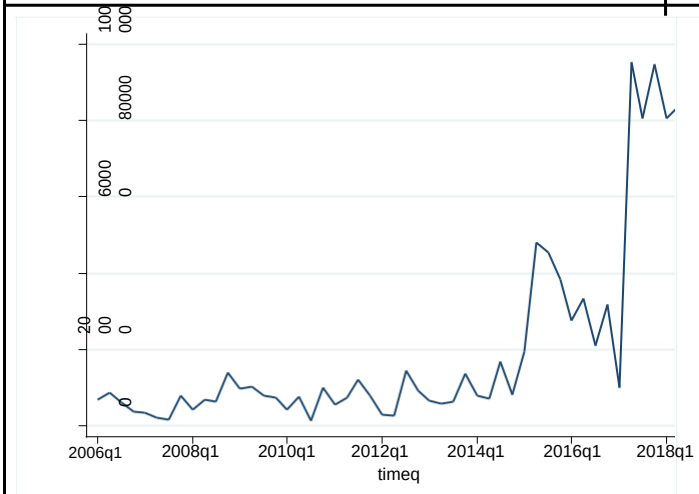
Cotton



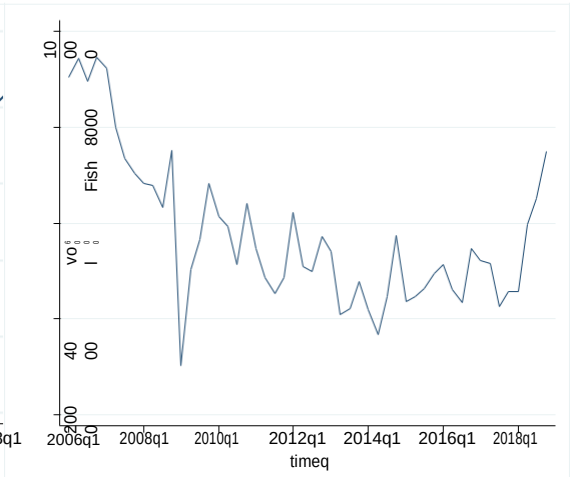
Coffee



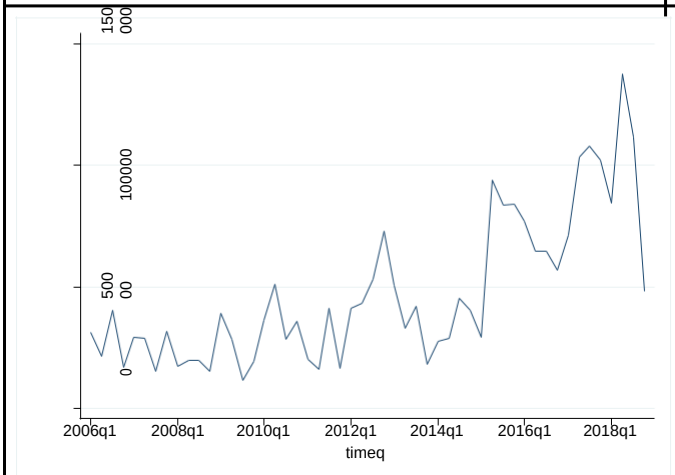
Beans



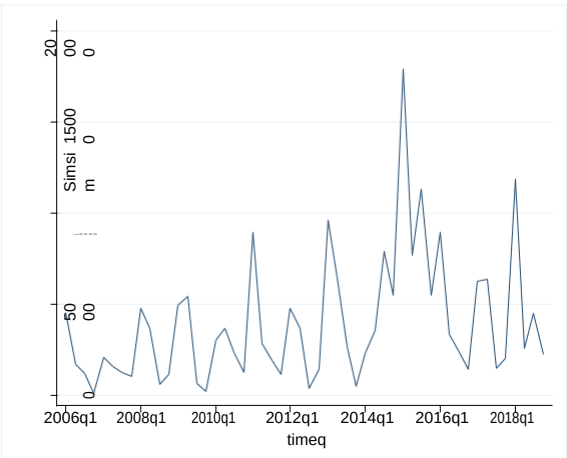
Fish



Maize



Simsim



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