Determinants of Imports in East African Community: A Comparative Analysis Using Poisson Pseudo Maximum Likelihood Estimator

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Abstract

Petroleum imports are crucial for the East African Community’s economic activities and economic growth (EAC). They facilitate exports oriented industries
and contribute up to 33% of the GDP. This study models fuel and road vehicle import determinants using a desegregated panel data from 1995 to 2020, including the impact of exogeneous chocs. Results vary across countries and products. Petroleum imports are income-elastic only in countries with direct access to the sea, such as Kenya and Tanzania, but road vehicle imports are elastic concerning incomes only in Uganda. Further, petroleum imports increased with relative prices in Kenya, Tanzania and Uganda. In contrast, road vehicle imports grew with price in all EAC’s countries, implying high import demand at higher import prices. The real depreciation of local currency has little or no effect to import demand. Trade liberalisation has only impacted Kenya, where a positive impact is seen for petroleum imports, and no effect is found for road vehicle imports. As political violence has a more substantial adverse effect on imports of petroleum for Uganda, 16.3%. EAC member countries should take various policies that reduce import dependence like investing in oil exploitation and diversifying investments in other green energy sources, such as wind and solar energy.

**JEL Classification:** C01, C51, F14, F15

**Keywords:** Imports, East African Community, Petroleum, road vehicles, PPMLHDFE estimator.

1 **Introduction**

Imports have increased considerably over the past three decades in the EAC\(^1\). The pick in imports was observed in 2014, where they reached 769, 18396, 2470, 11993 and 6074 million USD from 139, 3192, 281, 1712 and 1594 million USD, respectively, for Burundi, Kenya, Rwanda, Tanzania, and Uganda. The increase in imports is partially attributed to the increasing population in the region, causing increased domestic demand in 2013. Increased domestic demand for diversified products resulting from rapid population growth and industrialisation led to increased imports. Since small countries are generally unable to meet all the domestic demands of their populations, they will continue to import a certain amount of most goods from the rest of the world as the population increases.

Despite the increasing demand for imports, its determinants have received little attention despite their significance on economic growth.

Petroleum is one of the essential products that the EAC’s population depends on for its economic activities. Sectors such as transport, industries, power generators, and buildings, are fully met through imports, as fuel is not extracted in EAC due to the lack of suitable infrastructures and equipment as well as lack of political

\(^1\) The EAC is currently made by seven member countries such as Burundi, Kenya, Democratic Republic of Congo, Rwanda, South Sudan, Tanzania and Uganda. However, Democratic Republic of Congo and Sudan will not be included in our analysis given the lack of sufficient data due to their recent adhesion to the community.
willingness to extract the petrol. As for the imports of petroleum, roads imports have increased in recent decades.

**Figure 1:** Merchandise imports in EAC countries, 2001-2018 (in current millions of US$)

**Figure 2:** Imports of petroleum and road vehicles (in millions USD)

Source: Authors’ compilations, data from UNCTAD

Although imports are noted as being crucial for the EAC economy, their demand is often contentious due to global price instability and electoral violence. This may affect economic growth as any chock to the price or distribution of fuel affects demand for other products. For instance, the ongoing invasion of Ukraine, which has had deep human, social, and economic impacts across countries and sectors, adds another layer of consideration. For example, the nearly 26% rise in fuel prices following Russia’s invasion of Ukraine led Burundians to fear further increases when purchasing imported foodstuffs, which are indexed to fuel prices. Bugoma
Suwadu Bugoma, Noureddine Abdellatif and Gilbert Niyongabo (2022) found that political crises disproportionately affect EAC’s imports, with a higher negative impact found for Burundi due to the failed putsch in 2015.

The current study, therefore, analyses the determinants of imports and the impact of exogenous shocks in the EAC’s countries. Our interest in EAC’s countries is motivated by the fact that EAC is perceived as a regional integration model. Thus, understanding trade structure and its challenges will help EAC’s countries better benefit from the integration. For econometric analysis, we build on the existing studies on the demand for imports (see for e.g. Ayodotun and Farayibi, 2016; Narayan and Narayan, 2005).

We improve on them by introducing exogenous shocks in demand and estimating dynamics at a product level. We apply a fixed effect model, and add dummy variables to capture the impact of electoral violence and trade liberalisation. We control for unobservable characteristics of countries. We test for hidden correlation, and use Ordinary Least Squares (OLS) and the Poisson Pseudo Maximum Likelihood High Dimensional Fixed Effects (PPMLHDFE) estimators for regression. These estimators are suitable in our case.

This study contributes to the literature of the determinants of imports in the EAC region. Although a growing number of empirical studies have examined the determinants of imports in developing countries, within the context of EAC appear non-existent. We provide comparative and comprehensive empirical evidence of the determinants of import demand in countries using advanced estimations techniques. For policymakers, the results of this study inform measures to reduce import dependence. The comparative analysis between products and between countries gives a clear idea of how to position oneself strategically in order to make the most benefit of the integration. Thirdly, we contribute to the debate on the economic costs of political violence that has shaken Sub-Saharan Africa since the independence era in the 1960s.

The remainder of the article is divided as follows. In the following section, we briefly review the existing studies on the demand for imports and survey the literature on the economic costs of electoral violence in the EAC. In section 3, we discuss the model to explain the determinants of imports in the EAC. Section 4 presents the findings, and section 5 concludes this study.

2 Literature review

Academic literature has a long- and well-established tradition determining the components of demand for imports. Several theories have emphasised determinants of import demands. For instance, the comparative advantage theory focuses on how changes in relative prices can affect the volume and direction of international trade (Schumacher, 2013). Also, the perfect substitute model, commonly known as the Keynesian import demand function, is based on the macroeconomic multiplier analysis. This model assumes relative prices to be rigid while employment is considered variable. The accent is put on international capital movements, which are assumed to adjust to restore the trade balance passively. Here, the average and
marginal propensity to import and the income elasticity of imports are the key drivers in defining the relationship; (iii) the imperfect competition that focuses on intra-industry trade and explains the effects of economies of scale, product differentiation and monopolistic competition on international trade. Three approaches are used to define the impact of imperfect competition on international trade, such as the Marshallian, Chamberlinian and Cournot approaches (Gaalya, Edward & Eria, 2017).

With regards to energy imports, there are, among others, studies for Brazil (Alves and De Losso da Silveira Bueno, 2003), Indonesia (Sa’ad, 2009), Mexico (Galindo, 2005; Camacho-Gutiérrez, 2010), Nigeria (Dayo and Adegbulugbe, 1987; Iwayemi et al., 2010), Sri Lanka (Amarawickrama and Hunt, 2008), Barbados (Moore, 2011), India (Ghosh, 2009), Pakistan (Khan and Ahmad, 2008), South Africa (Ziramba, 2010), Turkey (Altinay, 2007; Ediger and Berk, 2011; Ozturk and Arisoy, 2016) or Fiji (Narayan and Narayan, 2005). In developed countries, studies for US (Liu, 2014), China (Zhao and Wu, 2007; Roberts and Rush, 2012), Korea (Kim and Baek, 2013) and studies for EU (Polemis, M. L. (2007) or from panel models where groups of countries such as EU or OECD countries are considered (Fedoseeva and Zeidan, 2018; Griffin and Schulman, 2005; Adeyemi et al., 2010) are worth noting. These studies mostly agree that prices and income are the drivers of energy demand, which is often elastic to changes in both variables. However, results vary significantly across countries and periods.

Moore (2011) employed monthly data from 1998 to 2009 and used the bounds testing approach to evaluate oil import demand for Barbados. His results suggested that, given their small price elasticities, oil imports are a good source of tax revenue. Kim and Baek (2013) used a similar econometric approach to quarterly data from 1986 to 2010 to investigate crude oil import demand in Korea. According to their findings, income was a more powerful determinant of the long-run behaviour of crude oil imports than the crude oil price. In the short run, the price seemed to be more important.

Moreover, Narayan and Narayan (2005) used bounds testing approach to cointegration for the period 1972 to 1999 in Fiji. They found the coefficient on income elastic while the coefficient on relative prices is unitary elastic in the long run. In India, Ghosh (2009) showed that the link between income and crude oil imports is statistically significant as 1% increase of GDP, leads to 1.97% increase in crude oil import. In constrast, price elasticity appears to be negative (-0.63) but statistically insignificant at 5% level.

Other scholars used the error-correction model (ECM) to analyse the demand for imports. Using vector ECMs, Zhao and Wu (2007) analysed China’s energy import demand for 1995–2006. They found that in the long run, the growth of industrial production and expansion of the transport sector affected oil imports, while domestic energy output had a substitution effect. Narayan and Smyth (2005) investigated the determinants of import demand in Brunei Darussalam and the impact of population and oil prices on import demand. They applied ECM and cointegration with bounds testing. They found that aggregate imports are inelastic in the short run and long run concerning income and world petroleum prices, but
they are elastic concerning population. So far, Ziramba (2010) has applied a similar econometric approach to annual data (1980–2006) to analyse the South African import demand for crude oil. He found that income and oil prices are the main factors that explain imports. Adewuyi (2016) is the only study looking at import demand beyond crude oil, emphasising the possibility of different elasticities related to import demand for refined petroleum products in Nigeria for 1984–2013. Contrary to previous studies, he analysed long-run and short-run import demand determinants for total and specific petroleum products by employing the autoregressive distributed lag (ARDL) bounds test cointegration method. His findings are interesting as they align with the theory. Real effective exchange rate aggregate income, manufacturing sector’s income, domestic energy production and population growth rate (PGR) seem to be drivers of the import of refined motor spirit. Also, the real effective exchange rate and the total output of petroleum products are major drivers of the total import of refined petroleum products in Nigeria.

While some scholars have put much interest in income and price effects on imports, others have focused more in money illusions (see among others, studies by Narayan and Smyth, 2005; Shaista Alam et al., 2010; Gaalya, Edward and Eria, H., 2017; Kemal, 2005). Kemal (2005) pointed out that exchange rates strongly influence a country’s trade as shifts in the exchange rate result in changes in a country’s import demand. In growth driven economy such as Pakistan, Alam and Ahmed (2010) found that, in the long run, real depreciation of local currency and volatility of real effective exchange rate do not impact the import demand.

However, much less is known about import demand at desegregating levels in EAC’s countries. Gaalya, Edward and Eria, (2017) established the effects of trade openness on disaggregated imports. A sample of annual cross-country panel data of EAC countries covering the period 1994–2012 is used. Here, a panel data cointegration technique that uses the Fully Modified Ordinally Least Squares and Dynamic Ordinally Least Squares was employed. They found that an increase in the tariff rate decreases imports at the aggregate and disaggregated levels. Income, price and exports positively influence the aggregate and disaggregated levels of imports, but the real effective exchange rate negatively influences imports both at aggregate and disaggregated levels.

3 Methodology

3.1 Model specification

Traditionally the aggregate import demand equation is a function of income and prices. Following Khan (1977), the import demand function can be written as:

\[ M_{it} = f(GDP_{it}, PM_{it}, PD_{it}) \]  (1)

Where GDP\(_{it}\) = the real gross domestic product, \(M_{it}\) = quantity or volume demanded of the \(i^{th}\) product, \(PM_{it}\) = the price of the \(i^{th}\) import product, \(PD_{it}\) = the price of the \(i^{th}\) domestic product, \(i\) = country subscript and \(t\) = time subscript.

We rewrite Equation (1) into an econometric form as follow:
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\[ M_t = \beta_0 + \beta_1 GDP_t + \beta_2 PM_{it} / PD_{it} + \varepsilon_t \]  

(2)

In logarithmic form, the import demand can then be written as follows:

\[ \ln M_t = \beta_0 + \beta_1 \ln Y_t + \beta_2 \ln Price_{it} + \varepsilon_t \]  

(3)

Where \( Price_{it} \) denotes relative import price i.e \( Price_{it} = (PM_{it}/PD_{it}) \). \( \beta_0, \beta_1 \) and \( \beta_2 \) are the coefficients for the exogenous variables, and \( \varepsilon_t \) is the error at time t.

Theoretically, the coefficient \( (\beta_1) \) of the GDP is assumed to be positive, whereas the coefficient \( (\beta_2) \) of the relative prices is expected to be negative.

Scholars have criticised this traditional model as it implies the absence of money illusions (exchange rate) and other structural factors that may influence import demand, such as population and trade policy agreements. Scholars have demonstrated that exchange rates play a key role in determining import flows (see among others Shaista Alam et al. (2010), Narayan and Smyth (2005), Gaalya, Edward and Eria, H. (2017)). Generally, an increase in the real exchange rate would increase import demand as import becomes cheap.

Trade liberalisation is the key feature across EAC. In 2005, the EACU was implemented to boost intra-regional trade significantly. Article 3 (a) of the treaty of the establishment of the EACU aims to further liberalise intra-regional trade in goods on the basis of mutually beneficial trade arrangements among the Partner States. To capture the effect of the EACU, we follow the study by Dutta and Nasir (2004), who found that a liberalisation dummy was an important determinant of the import demand function for India. We include a dummy variable with the value of 1 for the period the importer country has signed the EACU and zero otherwise. The sign of this dummy variable may be positive or negative depending on the impact of trade liberalisation. A positive sign means a positive impact, whereas a negative sign leans a negative impact of trade liberalisation on EAC member countries’ imports. Ignoring the population size effect in analysing imports’ determinants may result in biased estimations. In a study by Anaman and Buffong (2001), the population was found to be the most influential determinant of import demand in Brunei Darussalam. Lastly, other exogenous factors, such as electoral violence, may shape EAC’s trade flow pattern. The existing literature shows no direct causal link between violent conflict and imports in the EAC. Thus, we try to build a model that will meet the purposes of the study. Thus, we modify the model by adding a dummy variable to account for electoral violence effects following Bugoma (2022). This variable takes 1 for electoral violence periods in the importer country and zero otherwise.

The interest in this modelling process is to attempt to model import demand, taking our study’s objectives and scope into consideration. We measure the sensitivity of import demand to changes in income, price, exchange rate, population, trade liberalisation and electoral violence variables by estimating equation (4) as:

\[ \ln M_{it} = \beta_0 + \beta_1 Y_{it} + \beta_2 Price_{it} + \beta_3 RER_{it} + \beta_4 Pop_{it} + \beta_5 EACU_{it} + \beta_6 Viol_{it} + \varepsilon_{it} \]  

(4)

where RER denotes the real effective exchange rate, Pop denotes the size of the population and EACU stands for trade liberalisation. The income elasticity of demand for imports is expected to be positive, while price elasticity is expected to be negative. Moreover, according to the theoretical foundation, we expect the effect
of exchange rate and electoral violence on import demand to be negative. In contrast, trade liberalisation and population are expected to positively influence import demand in the EAC. We include importer fixed effects to capture all the unobservable countries’ specific characteristics that may influence import demand in a given country (Wooldridge, 2008, 2018).

\[
\ln M_t = \beta_0 + \beta_1 Y_t + \beta_2 \text{Price}_t + \beta_3 \text{RER}_{ijt} + \beta_4 \text{Pop}_t + \beta_5 \text{EACU}_t + \beta_6 \text{Viol}_i + \lambda_i + \epsilon_t \quad (5)
\]

Where \( \lambda_i \) stands for importer fixed effects, other variables remain as defined earlier. This model is directly relevant to our case because it considers the exogenous shocks. Then, the global model (5) is divided into two sub-models a and b, respectively, for petroleum imports and road vehicles imports as follows:

a. \( \ln M_{Petrol_{it}} = \beta_0 + \beta_1 Y_{it} + \beta_2 \text{Petroleum Price}_{it} + \beta_3 \text{RER}_{ijt} + \beta_4 \text{Pop}_t + \beta_5 \text{EACU}_t + \beta_6 \text{Viol}_i + \lambda_i + \epsilon_{it} \)

b. \( \ln M_{Veh_{it}} = \beta_0 + \beta_1 Y_{it} + \beta_2 \text{RelPrice}_{it} + \beta_3 \text{RER}_{ijt} + \beta_4 \text{Pop}_t + \beta_5 \text{EACU}_t + \beta_6 \text{Viol}_i + \lambda_i + \epsilon_{it} \)

### 3.2 Estimation techniques

Following Wooldridge (2010) and Greene (2012), we chose between fixed and random effects estimators by performing the Hausman test. Briefly, the fixed effect estimator considers the individual effect of each cross section by assuming that the slope coefficients are constant across individuals but allowing the intercept to vary for each individual. Different dummy variables are used to represent each individual or cross-section. On the other hand, the random effect estimator treats the individual effects as random disturbances, estimating the variance components for individual and error, assuming the same intercept and slopes. Thus, after doing a Hausman test to test the suitable model in our case, the result led to adopting a fixed effects model. The analyses are done using STATA 17.0. For regressions, we use OLS and PPMLHDFE estimators. It is well known that when the residuals are correlated across observations, OLS standard errors can be biased and either over or underestimate the true variability of the coefficient estimates (Petersen, 2009). However, OLS standard errors are unbiased when the residuals are independent and identically distributed. It is commonly debated by other authors that, in large panel data (T<N), OLS are unbiased (Greene, 2008). However, given the heteroscedasticity problem due to the panel data structure, we also use the PPMLHDFE estimator, as Correia et al. (2020) suggested. Instead of examining only EAC as a single economic bloc, we consider individual EAC member countries. Such an approach is suitable for comparative analysis.

### 3.3 Data sources

The data set for the analyses comprises imports of petroleum and road vehicles, income, price, exchange rate and population. Petroleum and roads vehicles import data are obtained from the United Nations Commission for Trade and Development (UNCTAD), while the World Development Indicators (WDI) provide data for the remaining variables. The gross domestic product (GDP) is used as a proxy for income. GDP deflator is used as a proxy for the domestic price index, while the import value index is used as a proxy for foreign prices. The official exchange rate is used as a proxy for the real exchange rate as there is no data for all EAC’s
countries for this variable. The authors constructed dummy variables for trade liberalisation (EACU) and electoral violence (Viol).

4 Findings

4.1 Descriptive Analysis

Table 1 shows the summary statistics of the variables drawn for the study.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>lnMPetrol</td>
<td>105</td>
<td>19.562</td>
<td>1.63</td>
<td>15.952</td>
<td>22.147</td>
</tr>
<tr>
<td>lnMVeh</td>
<td>105</td>
<td>19.049</td>
<td>1.391</td>
<td>16.06</td>
<td>21.056</td>
</tr>
<tr>
<td>lnGDP</td>
<td>105</td>
<td>23.14</td>
<td>1.327</td>
<td>20.481</td>
<td>25.335</td>
</tr>
<tr>
<td>lnRelPrice</td>
<td>105</td>
<td>1.514</td>
<td>.588</td>
<td>275</td>
<td>2.583</td>
</tr>
<tr>
<td>lnOER</td>
<td>105</td>
<td>6.612</td>
<td>1.203</td>
<td>4.209</td>
<td>8.223</td>
</tr>
<tr>
<td>lnPop</td>
<td>105</td>
<td>16.912</td>
<td>.738</td>
<td>15.669</td>
<td>17.905</td>
</tr>
<tr>
<td>EACU</td>
<td>105</td>
<td>.724</td>
<td>.449</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Viol</td>
<td>105</td>
<td>.114</td>
<td>.32</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: Authors’ computation.

Notes: lnMPetrol, lnMVeh, lnGDP, lnRelPrice, lnOER, lnPop are the natural logarithm of imports of petroleum, imports of road vehicles, gross domestic product, relative prices, official exchange rate and population.

Results revealed that the average import of petroleum products over the period was about 19.56%, with a minimum 15.95% and a maximum of 22.15%. For road vehicles, the average import over the period was about 19.05%, with a minimum of 16.06% and a maximum of 21.05%. The GDP averaged 23.14%, with a maximum of 25.33% and a minimum of 20.48%. Other variables registered an average of 1.51%, 6.61%, 16.91%, 0.72% and 0.11%, respectively, for the prices, exchange rate, population, trade liberalisation and electoral violence dummy variables.

4.2 Correlation analysis

Figure 3 shows the correlation between the main dependent variables of our study. It indicates the association’s extent and strength between the two variables. The demand for petroleum is correlated to the increased demand for road vehicles. Statistics reveal that the correlation between these two products is about 0.72, 0.79, 0.65, 0.85 and 0.95 for Burundi, Kenya, Rwanda, Tanzania and Uganda, respectively. This study accounts for both imports of petroleum and road vehicles.

Table 2 presents the correlation matrix of the explanatory variables employed for the analysis. The table presents all the possible combinations of petroleum and road vehicle import demands and their determinants in EAC’s countries. This helps to ascertain patterns of linear association between imports and their determinants, aiding the understanding of the econometric results and other analyses carried out in this study. Both import demand for petroleum products and road vehicles have a linear relationship with GDP and population, with a positive relationship. However, results show a weaker but positive relationship between imports with prices. Import
demand did not correlate with the exchange rate for petroleum and road vehicle products. It is the only variable that witnessed a low and negative association with import demands.

![Figure 3: Correlation between petroleum and road vehicles imports](source: Authors’ computation)

**Table 2: Sample Correlation Matrix**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Petrol</th>
<th>Veh</th>
<th>GDP</th>
<th>Petprice</th>
<th>RelPrice</th>
<th>Pop</th>
<th>OER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petrol</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Veh</td>
<td>0.893</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDP</td>
<td>0.780</td>
<td>0.914</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Petprice</td>
<td>0.406</td>
<td>0.319</td>
<td>0.149</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RelPrice</td>
<td>0.305</td>
<td>0.246</td>
<td>0.153</td>
<td>0.427</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pop</td>
<td>0.717</td>
<td>0.850</td>
<td>0.849</td>
<td>0.076</td>
<td>0.133</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>OER</td>
<td>0.116</td>
<td>0.099</td>
<td>0.037</td>
<td>0.038</td>
<td>0.203</td>
<td>0.133</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Source: Authors’ computation

**4.3 Estimation Results**

Following what has been suggested in many studies regarding panel data with periods larger than countries (T>N), we run an estimation controlling for country-specific characteristics that may influence results by considering country effects. On the one hand, we apply OLS estimator for comparison purposes and in another hand, we replicate previous estimates by applying the PPMLHDFE estimator. In this case, the PPMLHDFE estimator used is robust to statistical separation and convergence issues as developed in Correia et al. (2020). Results are provided in Table 3 and Table 4, respectively, for petroleum and road vehicle imports.

**4.3.1 Investigating the determinants of petroleum imports**

The significance of the model varies across countries. The results generated by the model are significant, as revealed by the adjusted $R^2$. It shows that 70.4%, 67.5%, 93.3% and 97.5% of the variation in the import demand of petroleum are
explained by all the explanatory variables in the model, respectively Kenya, Rwanda, Tanzania and Uganda. In Burundi, the selected variables explain only 45.1% of petroleum imports. Despite that, the probability value of 1% shows that the variables are strongly significant in explaining import demand in each EAC’s country. The results in Table 3 suggest that incomes increase petroleum imports volume in Kenya and Tanzania as all estimations show positive and statistically significant coefficients associated with importers’ GDP for Kenya (1.657) and Tanzania (5.624), meaning that a 1% increase in GDP increases petroleum imports by [1.657*ln(1.01)] =0.0165 and [5.624*ln(1.01)] =0.056 respectively for Kenya and Tanzania. However, no statistically significant coefficients are found in landlocked economies such as Burundi, Rwanda and Uganda. These results align with findings by Sa’ad (2009), Iwayemi et al. (2010) and many other studies in developing countries.

Contrary to our expectations, the coefficient associated with relative prices is not significant for EAC’s small economies, such as Burundi and Rwanda but is positive and significant for Kenya, Tanzania and Uganda, with a greater significance in Uganda and Kenya. This implies that import dependence in these countries is inevitable as petroleum is a necessity in less developed economies and petroleum, which is among the key driver of economic activities, is not yet exploited in these countries. This situation leads to the fact that these countries will continue to import petroleum independently of the rise in petroleum prices in the global market. Ayodotun and Farayibi (2016) found similar results in SSA countries.

The probability values reveal that the official exchange rate is insignificant in explaining EAC import demand. An exception is pointed out in Kenya and Tanzania when PPMLHDFE estimator is used, where statistically significant coefficients of 3.086 and 3.376 are found, respectively. This suggests that being the only EAC countries with direct access to the sea, likely relative prices, Kenya and Tanzania will continue to import petroleum despite the appreciation of the foreign currency. These results align with findings by studies in developing countries such as Shaista Alam et al. (2010), Narayan and Smyth (2005), Ayodotun and Farayibi (2016), where depreciation of the local currency does not affect decreasing import demand.

Likely, the population has no impact in Rwanda and Burundi. Surprisingly, a negative statistically significant coefficient is found for Kenya (-7.778) and Tanzania (-20.72) for both estimation techniques indicating that petroleum imports decrease with population. These results could be attributed to the border effects in landlocked countries (such as Burundi and Rwanda) and in countries with direct access to the ocean (such as Kenya and Tanzania). However, a positive effect is found for Uganda (1.62), suggesting that 0.016% of imports of petroleum products grew following a 1% increase in the population of Uganda. This result aligns with the findings by Anaman and Buffong (2001). These previous results seem valid since petroleum imports to Burundi, Rwanda, and Uganda pass mostly through the North and the Central Corridors via Mombasa and Dar-es-Salaam ports, respectively (Figure 4). According to Bugoma (2022), 80% of EAC imports consisting of petroleum products, machinery and medicines came from Middle
Eastern trading partners, including China, India and the United Arab Emirates and passed through Kenya (via the North Corridor) and Tanzania (via the Central Corridor) before being routed to Uganda, Burundi and Rwanda in 2018.

The estimated coefficient of EACU is statistically insignificant, suggesting that EACU has no effect over time on petroleum imports of EAC’s countries under trade liberalisation policy. But, again, the effects largely differ among EAC member countries as the signs differ among countries with negative but insignificant impacts for Burundi, Rwanda and Uganda. A positive effect of about over \(100^*(e^{2.072} - 1) = 697.06\%\) is found in Kenya. This captures the effect of trade liberalisation on the import demand behaviour of Kenya, which has decreased by seven-time more. These results have an economic implication on trade creation and then welfare increase in Kenya. This is in accordance with the findings of Harvey and Sadegah (2011) who found that trade liberalisation played a significant role in both long-run and short-run elasticities of import demand. Buigut (2012) found similar findings in the case of EAC.

![Map of roads linking landlocked EAC countries and the ports of Mombasa and Dar es Salaam](image)

Source: Kaminichia (2020).

In determining if the effects of political crises are equally distributed across EAC, results reveal that a negative coefficient is reported in Burundi and Uganda. In Burundi, the impact is negative (-0.0945) but not significant, while it is strongly significant for Uganda, indicating that the occurrence of election violence will decrease petroleum imports by \(100^*(e^{-0.178} - 1) = 16.3\%\). These results align with findings by Aisen and Veiga (2013) and Durnev et al. (2012), suggesting a negative impact of various forms of political instability on macroeconomic aggregates. In Kenya, in contrast, no effect was found.
4.3.2 Investigating the determinants of road vehicles imports

The joint significance shows that the model explains road vehicles’ import demand with a probability value of 1% significance. The high adjusted $R^2$ indicates that variations in road vehicle import changes in the selected variables highly explain demand. The results show that 83.5%, 93.3%, 96.8%, 96.4% and 98.2% of the variation in the import demand of road vehicles are explained by all the explanatory variables in the model, respectively for Burundi, Kenya, Rwanda, Tanzania and Uganda.

The results in Table 4 suggest, likely for petroleum imports, there are various outcomes between EAC’s countries regarding road vehicle demand. Road vehicle imports are income elastic only in Uganda, where a positive and strongly statistically significant coefficient is found using both estimators. A coefficient of 1.053 from OLS estimator indicates that a 1.053% increase in road vehicle imports results in a 1% increase in GDP of Uganda. There is no effect of income on-road vehicle imports for the rest of the countries. With regards to relative prices, the coefficient associated with relative prices is significant for all economies, with a strong significance in Kenya, Tanzania, Uganda, and Rwanda. This implies that road import dependence in these countries grows with prices.

As for the exchange rate, the result reveals that the official exchange rate is insignificant in explaining import demand in Burundi, Kenya and Tanzania, where either OLS or PPMLHDFE estimators have shown a non-statistically significant coefficient. An exception is pointed out in Rwanda and Uganda when PPMLHDFE estimator is used: a positive and statistically significant coefficient is found (2.098 and 1.028, respectively for Rwanda and Uganda). This suggests that likely relative prices, Rwanda and Uganda will continue to import road vehicles despite the appreciation of the foreign currency. These results contradict Gaalya, Edward and Eria, H. (2017) and Kemal (2005) who found that the exchange rate strongly influences Pakistan’s trade. The population has no impact in Burundi, Kenya and Tanzania. However, surprisingly, a negative statistically significant coefficient is found in Rwanda and Uganda, indicating that a 1% increase in population reduces road vehicle imports by 6.79% and 1.9%, respectively, for Rwanda and Uganda.

Both estimated coefficients of EACU and political violence are statistically insignificant, suggesting that trade liberalisation and political crises during presidential elections in EAC have no statistical relationship with road vehicle imports of EAC’s countries. These results are contrary to Guillaumont et al. (1999) and Gurgul and Lach (2013), indicating that political instability negatively impacts the macroeconomic aggregate in Africa. However, although not statistically significant, a negative coefficient is reported in Kenya (-0.163 and -0.0825 for OLS and PPMLHDFE estimators, respectively).

4.4 Robustness checks

Several robustness tests were carried out for the reliability and validity of the results. Firstly, we computed the Hausman test to investigate whether the fixed effects or the random effects specification are good for our data, as proposed by Green (2012). Second, we check if time-fixed effects are needed for both model 1
and model 2 by running a fixed effects model using the command testparm. This is a joint test to see if the dummies for all years are equal to 0, if they are, then there is no need to include time effects in the model. We found that the Prob>F is 0.31 > 0.05 for petroleum imports and Prob>F is 0.0010 < 0.05 for road vehicle imports. We failed to reject the null hypothesis that the coefficients for all years are jointly equal to zero. Therefore, no time-fixed effects are needed for the petroleum imports model, but time effects are needed. We accounted for heteroskedasticity and/or autocorrelation via clustered standard errors by country and time levels. First, we present the OLS estimator with country-fixed effects and second, we apply PPMLHDFE estimator. We replicate previous estimations by clustering the standard errors, and we obtain the same results. In all cases, similar results are found, either we cluster or not the standard errors.
### Table 3: Determinants of petroleum imports: individual results

<table>
<thead>
<tr>
<th>Dependent variable: Petroleum imports</th>
<th>OLS</th>
<th>PPMLHDFE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Burundi</td>
<td>Kenya</td>
</tr>
<tr>
<td>lnGDP</td>
<td>-0.00213</td>
<td>4.321</td>
</tr>
<tr>
<td></td>
<td>(2.201)</td>
<td>(1.957)</td>
</tr>
<tr>
<td>lnPetprice</td>
<td>0.474</td>
<td>-0.106</td>
</tr>
<tr>
<td></td>
<td>(0.805)</td>
<td>(0.722)</td>
</tr>
<tr>
<td>lnOER</td>
<td>-1.356</td>
<td>5.167</td>
</tr>
<tr>
<td></td>
<td>(3.171)</td>
<td>(4.040)</td>
</tr>
<tr>
<td></td>
<td>(7.250)</td>
<td>(9.636)</td>
</tr>
<tr>
<td>EACU</td>
<td>-1.253</td>
<td>2.072</td>
</tr>
<tr>
<td></td>
<td>(0.878)</td>
<td>(0.942)</td>
</tr>
<tr>
<td>Viol_spec</td>
<td>0.176</td>
<td>0.381</td>
</tr>
<tr>
<td></td>
<td>(0.830)</td>
<td>(0.523)</td>
</tr>
<tr>
<td>_cons</td>
<td>-96.93</td>
<td>277.0</td>
</tr>
<tr>
<td></td>
<td>(64.46)</td>
<td>(117.5)</td>
</tr>
<tr>
<td>N</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td>R²</td>
<td>0.616</td>
<td>0.793</td>
</tr>
<tr>
<td>adj. R²</td>
<td>0.451</td>
<td>0.704</td>
</tr>
</tbody>
</table>

Source: Authors’ computations

Notes: This table reports estimates of determinants of petroleum imports of EAC’s countries. All estimates are obtained with data for the year 2000 to 2020. The dependent variable is petroleum imports. We use country fixed effects to control for unobservable characteristics of countries. Standard errors are reported in parentheses * p < 0.05, ** p < 0.01, *** p < 0.001
### Table 4: Determinants of road vehicles imports: individual results

<table>
<thead>
<tr>
<th>Dependent variable: Road vehicles imports</th>
<th>OLS</th>
<th>PPMLHDFE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Burundi</td>
<td>Kenya</td>
</tr>
<tr>
<td>lnGDP</td>
<td>0.000665</td>
<td>0.00822</td>
</tr>
<tr>
<td></td>
<td>(0.792)</td>
<td>(0.474)</td>
</tr>
<tr>
<td>lnRelPrice</td>
<td>1.174***</td>
<td>1.519***</td>
</tr>
<tr>
<td></td>
<td>(0.430)</td>
<td>(0.353)</td>
</tr>
<tr>
<td>lnOER</td>
<td>0.932</td>
<td>-1.499</td>
</tr>
<tr>
<td></td>
<td>(0.965)</td>
<td>(1.018)</td>
</tr>
<tr>
<td>lnPop</td>
<td>1.352</td>
<td>5.085</td>
</tr>
<tr>
<td></td>
<td>(2.013)</td>
<td>(2.401)</td>
</tr>
<tr>
<td>EACU</td>
<td>-0.113</td>
<td>-0.463</td>
</tr>
<tr>
<td></td>
<td>(0.306)</td>
<td>(0.251)</td>
</tr>
<tr>
<td>Viol_spec</td>
<td>0.153</td>
<td>-0.163</td>
</tr>
<tr>
<td></td>
<td>(0.262)</td>
<td>(0.135)</td>
</tr>
<tr>
<td>_cons</td>
<td>-11.66</td>
<td>-64.14*</td>
</tr>
<tr>
<td></td>
<td>(17.67)</td>
<td>(29.32)</td>
</tr>
<tr>
<td>N</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.885</td>
<td>0.953</td>
</tr>
</tbody>
</table>

**Notes:** This table reports estimates of determinants of road vehicles imports of EAC’s countries. All estimates are obtained with data for the year 2000 to 2020. The dependent variable is road vehicles imports. We use country fixed effects to control for unobservable characteristics of countries. Standard errors are reported in parentheses. *p < 0.05, **p < 0.01, ***p < 0.001
5 Conclusion and recommendations

This study analysed the imports of petroleum and road vehicles in five EAC’s countries, Burundi, Kenya, Rwanda, Tanzania and Uganda, from 2000 to 2020 using a comparative econometric approach. Descriptive analysis, correlation analysis, and fixed effects model were employed in examining the relationship between import demand and the variables selected by applying OLS and PPMLHDFE estimators.

Both sub-models – for petroleum and road vehicle imports – were globally significant as the probability value of 1% indicates that the variables strongly explain import demand in EAC’s countries. With regard to determinants of the import of petroleum and road vehicles in the EAC countries, results vary across countries and products. Petroleum imports are income-elastic only in countries with direct access to the sea, such as Kenya and Tanzania; however, income plays great role in road vehicle imports only in Uganda.

Petroleum imports were shown to increase with global price only in Kenya, Tanzania and Uganda, while road vehicles import growth with relative prices in all EAC countries, which implies that there is high import demand at higher import prices. This is contrary to the theory in the traditional literature on import demand, but it is meant for poor developing countries in general, EAC in particular. High production costs cum low levels of technology in developing countries make import demand for most manufactured goods inevitable. As prices rise, total import expenditure rises for these countries. Contrary to the theory, money illusions do not matter in EAC’s countries as the official exchange rate was found to have little or nonexistent significance in explaining import demand in EAC. Alam and Ahmed (2010) found that, in Pakistan, the real depreciation of local currency and volatility of real effective exchange rate do not impact the import demand in the long run. This results are obvious for growth driven economies.

Similarly, the population has no impact in Burundi and Rwanda except in Uganda; a positive impact of about 1.62 is found for Uganda. However, surprisingly, a negative statistically significant coefficient is found for Kenya and Tanzania implying imports have increaser higher than population. This was attributed to their geographical localisation as they are the only EAC’s countries with direct access to the sea. The major share of imports to the EAC countries pass through the ports of Mombasa (Kenya) and Dar es Salaam (Tanzania).

Trade liberalisation only impacts Kenya, where trade EACU protocol has increased Kenya’s petroleum imports by seven times. Contrary to our expectations, political violence effects are disproportionate across countries and products. It does have effect on imports of petroleum in Uganda where it reduces imports of petroleum by 16.3%. Although it is not significant, a negative coefficient for road vehicle imports was found for Kenya (-0.163 for OLS estimator and -0.0825 for PPMLHDFE estimator).

These results are similar to Bugoma (2022), who found disproportionate effects on determinants of imports in EAC member countries at aggregate level: Kenya
benefits the most from the integration agreements given its advanced economic level, and political crises have disproportionate effects on EAC’s imports. A higher negative impact was found for Burundi due to the failed putsch in 2015. This is in accordance with the findings of Sa’ad (2009), Iwayemi et al. (2010) and many other studies in developing countries, although results vary across developing countries.

In view of the findings, policies that reduce import dependence should be undertaken. Investments in oil exploitation will effectively reduce import demand, while one directed at increasing regional production would ease the shortage. Also, diversification of and investments in other green energy sources, such as wind and solar energy will decrease dependence on petroleum imports from outside.

This study has some limitations. First, the unavailability of data such as relative prices and real exchange rates in some EAC’s countries largely affected our results’ robustness. These data are important in analysing import demand behaviour with regard to exchange rate volatility. Second, the exogenous chocks to EAC trade are multiple and of various forms –climate change, covid-19, etc.–. Not taking into consideration other factors could also be a weakness of this study. When more data become available, an econometric analysis of the impact of other factors on import determinants for disaggregated import could be carried out in EAC. This can capture the import demand behaviour of EAC’s countries for specific goods.

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References


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