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Abstract

Research on AGOA's impact is largely scanty and findings are mixed. Most prior studies on AGOA have been carried out at a high degree of aggregation, estimating its effects on overall bilateral export flows, relying on variation by country and year that masks important differences across products. Born of a recommendation by the AGOA Response Office of Uganda, this study took a disaggregated product level approach to investigate the determinants of U.S. coffee import volumes from Uganda under the African Growth And Opportunity Act, 2000 (AGOA). Using an augmented gravity model, a random effects regression was performed on a disaggregated data panel of U.S. Coffee import volumes from Uganda that spanned the years 1994–2018 to establish; the main factors influencing the volume of U.S. coffee imports from Uganda and the effect of AGOA on U.S. coffee imports from Uganda. Artificial Neural Network (ANN) analysis was used to predict the future U.S. coffee imports from Uganda for the foreseeable future of AGOA, that is, till 2025. The main determinants of U.S. coffee imports from Uganda were found to be; air traffic, AGOA membership, U.S. openness to trade plus climatic factors like global CO_2 emissions and the mean surface temperature in Uganda. AGOA had a negative effect on total U.S. coffee imports from Uganda, however, the variety of coffee products imported by the U.S. from Uganda seem to have increased post-AGOA. U.S. coffee imports from Uganda were predicted be somewhat erratic between 2019-2025 but trend upwards. This study recommends that; firms should enter into more sophisticated and specialty coffee products with AGOA-status and take special care of climatic factors; policy makers should accelerate market positioning, branding, productivity and value-chain enhancement policies for coffee; researchers should investigate the effect of climatic factors further towards developing climate resilient varieties of coffee plus explore the effects of AGOA on other commodities so as to better exploit the provisions of AGOA.

Keywords: Trade Preference Systems, AGOA, Coffee import determinants, Climatic effect, Uganda

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List of Abbreviations

AGOA	The African Growth and Opportunity Act, 2000
ANN	Artificial Neural Network
EAC	The East African Community
GDP	Gross Domestic Product
GNP	Gross National Product
GSP	Generalised System of Preferences
LDBCs	Lesser Developed Beneficiary Countries
LDCs	Least Developed Countries
MFN	Most Favoured Nation
MSME	Micro-, Small and Medium Enterprises
PTA	Preferential Trade Agreement
RoO	Rules of Origin
SSA	Sub-Saharan Africa

Chapter 1: Introduction to the Study

1.1. Introduction

This chapter gives a background to the study that introduces the salient features of preferential trade agreements. It gives a brief history of AGOA, touches on U.S. – Uganda trade relations and ends with a statement of the problem, research objectives, questions plus brief note on the scope and significance of the study.

1.2. Background to the Study

1.2.1. Preferential Trade Agreements (PTAs)

A growing number of countries are taking part in preferential trade agreements (PTAs), which increasingly involve broader collaboration on policies encompassing far more than trade barriers. A Preferential Trade Agreement (PTA) is "an international treaty with restrictive membership and including any articles that (i) apply only to its members and (ii) aim to secure or increase their respective market access" (Limão, 2016). In order of increasing economic integration they include; Non-reciprocal PTAs - granting one-way preferences, e.g. the Generalised System of Preferences (GSP) and AGOA; Reciprocal PTAs - granting two-way preferential tariffs, like. the Latin American Free Trade Area (1960); Free trade areas (FTAs) - granting two-way preferential tariffs and removing tariffs on a significant portion of the trade, e.g. The North American Free Trade Agreement (NAFTA); Customs Unions (CUs) - FTAs with common external tariffs e.g. Turkey-EU, Southern Common Market (MERCOSUR); Common Markets (CMs) - like the European Union, which are CUs with freer mobility of labour and capital; Economic Unions (EUs) – like the Economic and Monetary Union of Central Africa (ECOWAS) and the Euro area countries, which are CMs with further fiscal and monetary policy coordination.

1.2.2. The African Growth Opportunity Act, 2000 (AGOA)

AGOA is a non-reciprocal PTA. It was enacted by the United States to lower trade barriers to Least Developed Countries (LDCs) by granting certain unilateral trade preferences to them. Enacted into U.S. law on 18th May 2000, it extended the GSP of the U.S. and duty-free treatment for selected textile and apparel goods left out under the GSP. This was achieved through the general AGOA provisions for textile and apparel (section 112) and the LDCs' 'special rule', otherwise known as the 'third-country fabric provision' (Fernandes et al., 2019).

For its ends, AGOA determined Sub-Saharan Africa (SSA) to consist of 49 states (South Sudan entered in 2012) and allowed the U.S. President to elect an SSA country as beneficiary subject to that country meeting the eligibility requirements outlined in the Act establishing AGOA. In 2015, AGOA was renewed an extra 10 years, to 2025 by President Barack Obama.

Annually the eligibility of beneficiary countries is reviewed. A report is presented to the U.S. Congress about the current and potential eligibility of each of the 49 SSA beneficiary countries designated. The AGOA membership has varied over time, from 34 in 2001 to 49 in 2017. Over 2001-2017 some members lost their eligibility owing to violations of the eligibility requirements connected with political freedoms, respect for the rule of law, and human rights violations, et cetera. (Fernandes et al., 2019).

Together, the GSP of the U.S. and AGOA account for approximately 6,500 duty-free product tariff lines (AGOA.info, 2019a). AGOA eligible SSA countries do not automatically qualify for preferences under the general textile and apparel provisions. An important prerequisite for eligibility under the general textile and apparel provisions (section 112) is that beneficiary countries must be certified as having an effective visa system, enforcement and verification procedures in place. This ensures that the products to which AGOA benefits are applied are produced in eligible SSA countries, meeting the rules of origin required to claim those benefits (USITC, 2014). By 2017, only 26 beneficiaries qualified for the general AGOA textile and apparel provisions. Among others, Burundi, Togo, and South Sudan did not

(Fernandes et al., 2019). The status of eligibility as of 2019 is shown in figure 1.1 below (AGOA.info, 2019c):

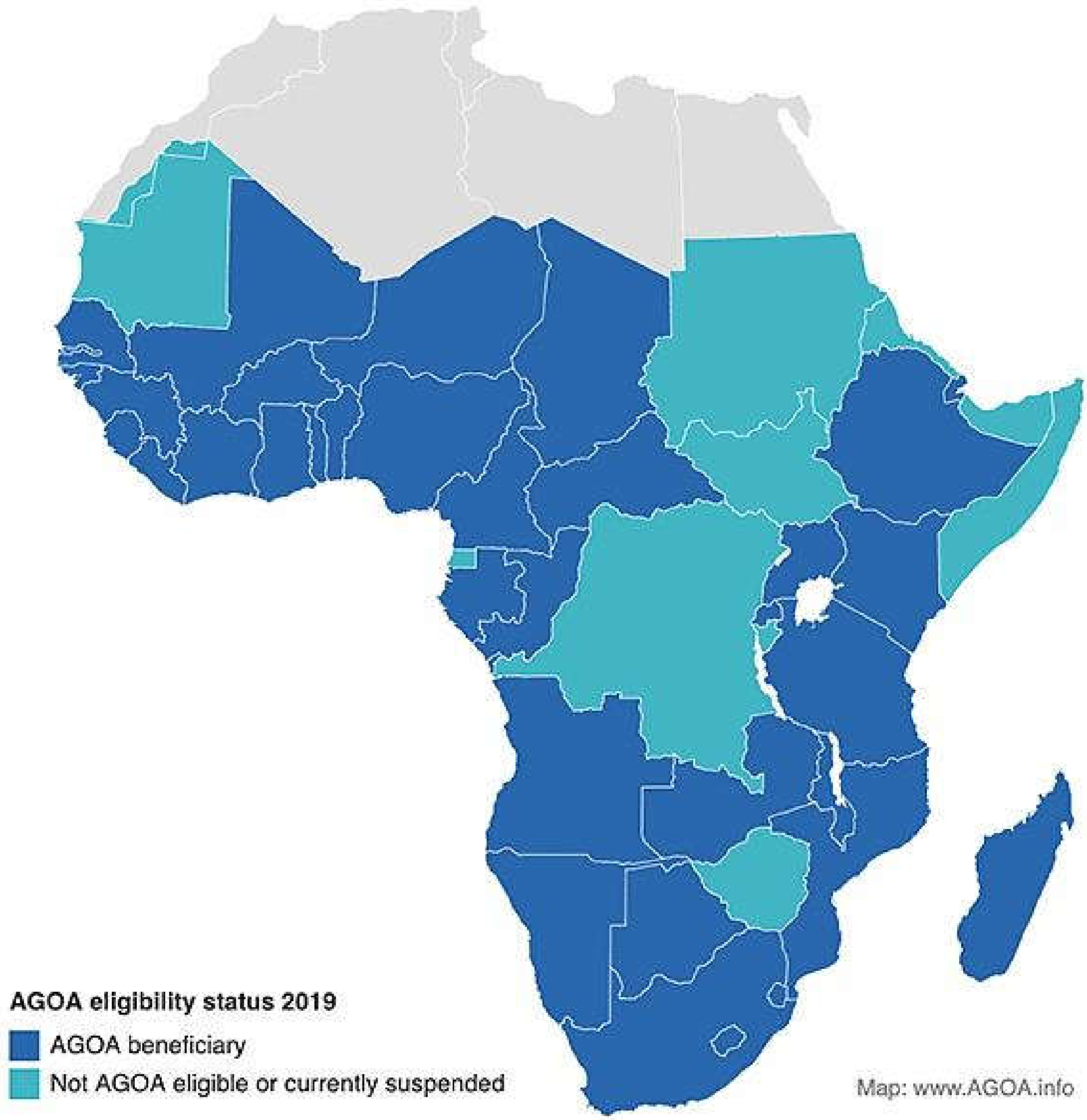


Figure 1.1: Sub-Saharan African Countries eligible for AGOA as at July 2019

1.2.3. The direction of Uganda's trade under AGOA

The proportion of Uganda's trade with the U.S. has remained as low as it was in 2000 (when AGOA started) and in 2015 (when AGOA was renewed a further 10 years to 2025). This fact is illustrated using data from the Central Bank of Uganda as seen in figure 1.2, 1.3 and 1.4 below.

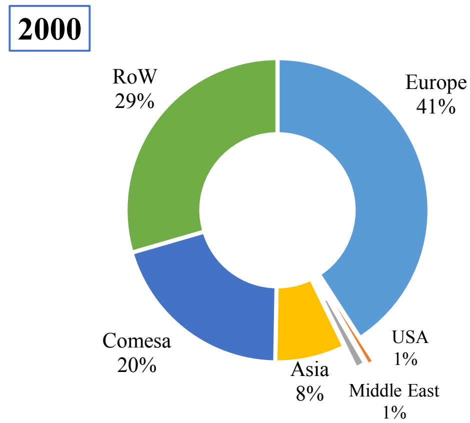


Figure 1.2: Direction of Uganda's Exports in 2000

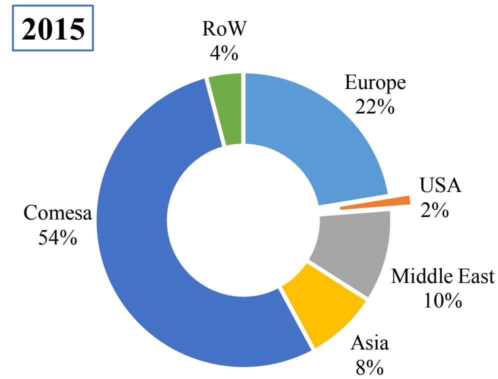


Figure 1.3: Direction of Uganda's Exports in 2015

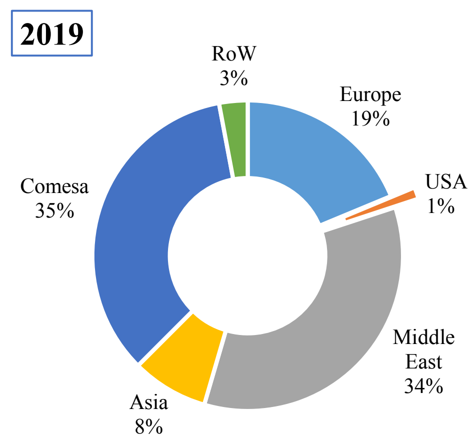
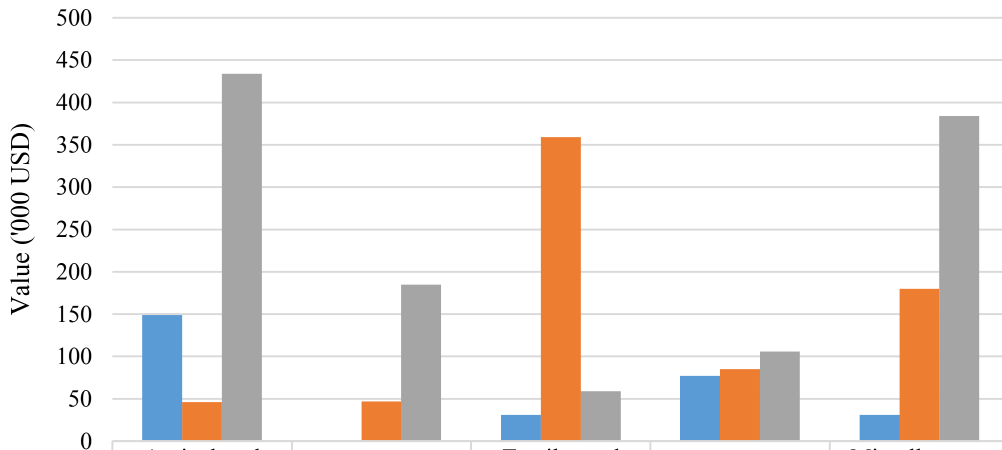


Figure 1.4: Direction of Uganda's Exports in 2019

1.2.4. Uganda's AGOA strategy and its dominant trade sectors

Uganda's AGOA strategy is enshrined in the AGOA 101 – UGANDA guide issued by the AGOA Response Office of the Ministry of Trade, Industry and Cooperatives (MTIC) of Uganda in May 2019. The strategy recommends the export of four product sectors namely; coffee, cut flowers, fish, plus textiles and apparel, which it presents as being in high-demand and of high-value. Consistent with that recommendation, figure 1.5 illustrates that agriculture is the most dominant sector in Uganda's economy under AGOA (Agoa.info, 2020).



	Agricultural products	Forest products	Textiles and apparel	Footwear	Miscellaneous manufactures
2016	149	0	31	77	31
2017	46	47	359	85	180
2018	434	185	59	106	384

Figure 1.5: U.S. AGOA imports from Uganda by sector

Further, coffee is the U.S.'principal import from Uganda and accounts for the bulk of Uganda's export revenues including revenue from AGOA (Agoa.info, 2020). Uganda produces what is generally considered by international markets to be the world's best Robusta coffee. Robusta coffee, in fact, is native to and originates from Uganda. According to the International Trade Centre, Uganda is the second biggest producer of coffee in Africa, after Ethiopia, but it is the largest exporter of coffee in Africa (ITC, 2016).

1.2.5. Uganda's historical performance on AGOA

Uganda remains the worst performer on AGOA in East Africa, as illustrated by figure 1.6 and 1.7 (AGOA.info, 2019b). In fact, since AGOA was enacted, Uganda has recorded significant fluctuations in its AGOA exports. Exports peaked in 2005 with a value of approximately USD 5 million and shrank to a low of less than USD 1 million in 2009. Exports have not fully recovered but are expanding. This fact is illustrated in figure 1.7 below (AGOA.info, 2019b).

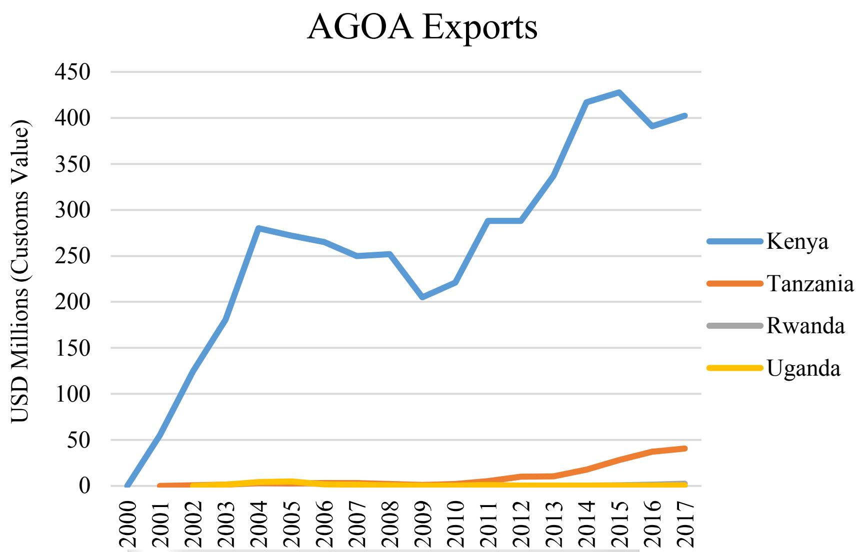


Figure 1.6: AGOA Exports from East African Countries

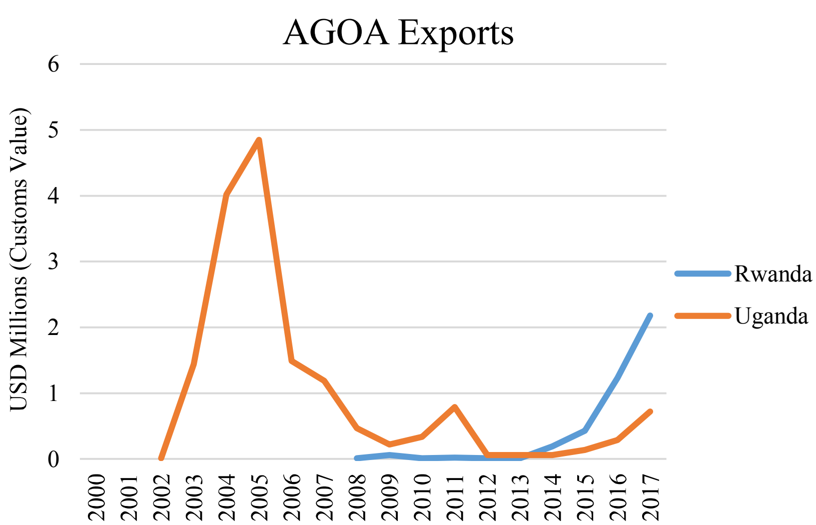


Figure 1.7: AGOA Exports from Uganda and Rwanda

The extension of the AGOA legislation until 2025 provides Ugandan exporters with an opportunity to further expand manufacturing and production, and to diversify and increase exports to the U.S (AGOA Response Office - MTIC Uganda, 2019).

1.3. Statement of the Problem

Uganda's official AGOA strategy recommends the export of coffee, presenting it as being in high-demand and of high-value. It further assumes that exporters or potential exporters have conducted the necessary market research, and are ready to export. (AGOA Response Office - MTIC Uganda, 2019).

However, 20 years on from the enactment of AGOA, empirical findings on its contribution to trade development remain largely inadequate and inconclusive (Klasen et al., 2016). Kassa & Coulibaly (2019) aver that while AGOA has contributed to a rise in exports for most beneficiary countries, these trade effects have varied by product and country. Further, the contrast in trade effects was mostly attributable to country-specific supply-side factors. Fernandes et al. (2019) admit that regional studies of AGOA may obscure interestingly dissimilar product and country-level trade effects, which raises questions about the still unresearched prospects for Uganda's coffee exports under AGOA. With low and volatile world coffee prices looming (UNCTAD, 2018), the USDA Foreign Agricultural Service (2019) also predicts a fall in 2019/2020 coffee production in Uganda due to drought. Moreover, Uganda's export performance under AGOA has been poor (AGOA.info, 2016; Mwesigwa, 2015) and contrary to the assumption that exporters or potential exporters will have conducted the necessary market research, there is evidence that exporters or potential exporters often lack the relevant information, training and skills to conduct the market research (Pasape, 2018; WTO, 2016), they also fear venturing into new businesses like export (Mpunga, 2016; Nassr, Robano, & Wehinger, 2016). In addition, various other factors such as; the stability of access to AGOA preference margins, product coverage, conditionality, rules of origin, among others could harm Uganda's AGOA performance (Persson, 2013).

This lack of specific country (Uganda) and product (coffee) level evidence given Uganda's poor past export performance under AGOA and doubtful coffee prospects leaves a gap, which presents a problem to those seeking to translate Uganda's AGOA strategy into action with any product. The current study solves this problem by taking a more disaggregated product level approach to investigate the determinants of U.S. coffee import volumes from Uganda under the African Growth and Opportunity Act, 2000 (AGOA).

1.4. Research objectives

1.4.1. General Objective

The general objective of this study is to investigate the determinants of U.S. coffee import volumes from Uganda under the African Growth and Opportunity Act, 2000 (AGOA).

1.4.2. Specific Objectives

The specific objectives of this study are:

i) To determine the main factors influencing U.S. coffee import volumes from Uganda.
ii) To explore the effect of AGOA on U.S. coffee import volumes from Uganda.
iii) To predict future U.S. coffee import volumes from Uganda under AGOA.

1.5. Research Questions

The questions of this study are:

i) What main factors influence U.S. coffee import volumes from Uganda?
ii) What effect has AGOA had on U.S. coffee import volumes from Uganda?
iii) What is the demand outlook for U.S. coffee import volumes from Uganda under AGOA?

1.6. Scope of the Study

This study investigates the determinants of U.S. coffee import volumes from Uganda under the African Growth and Opportunity Act, 2000 (AGOA) using annual panel data from 1994 to 2018. Data on exports from SSA countries are often missing (Kassa & Coulibaly, 2019), hence, annual U.S. imports data were be used to answer the research questions.

Uganda makes for an interesting case study for various reasons. First, it is one of the initial 34 SSA countries designated as eligible for AGOA. It has not had its preferential access withdrawn since inception and thus offers an uninterrupted timeline over which to study its performance under AGOA. Additionally, compared to its EAC counterparts, the Uganda government has been accused of numerous reports of human rights violations (U.S. Embassy in Uganda, 2019), which place it at a high risk of having its AGOA privileges withdrawn (Frazer & Steenbergen, 2017).

This research focuses on coffee because it is Uganda's principal export (Bank of Uganda, 2019). In fact, coffee is the U.S.' principal import from Uganda and accounts for the bulk of Uganda's export revenues including revenue from AGOA (Agoa.info, 2020). Uganda produces what is generally considered by international markets to be the world's best Robusta coffee.

1.7. Significance of the Study

Exporters and potential exporters could use this study as a blueprint for evaluating the viability of export business in any product sector under AGOA while policymakers could use it as a tool for testing similar trade policies - to guide their exploration and understanding of the main factors influencing trade in any specific product sector.

Researchers will benefit from this study because it supplements the emerging literature revisiting the effect of AGOA on Sub-Saharan countries. Most prior studies on non-reciprocal PTAs have been performed at high-degrees of aggregation, estimating effects of PTAs on total bilateral export flows, relying on variation by year and country that conceals important peculiarities across products (Fernandes et al., 2019). Though similar to Tadesse & Fayissa (2008) in its objectives, this study, further disaggregates the study of changes in exports to products at a country level as opposed to regional bloc level treatment.

Chapter 2: Literature Review

2.1. Introduction

This section briefly reviews some of the theoretical and empirical literature on non-reciprocal preference agreements with the focus on AGOA. The section is divided into the theoretical review, empirical review, research gap and conceptual framework.

2.2. Theoretical Review

2.2.1. The theories of international trade

All the mainstream economic theories of Absolute Advantage, Comparative Advantage and Heckscher-Ohlin (H-O) strongly advocate for trade between countries. Non-reciprocal trade agreements like AGOA, are historically expected to raise trade flows among the partners to the agreement, thereby contributing to enhanced long-run economic growth of the parties involved according to Tadesse and Fayissa (2008).

2.2.1.1. The theory of Absolute Advantage

The absolute advantage theory was proposed by a Scottish philosopher considered the father of modern economics, Adam Smith in 1776. In his epic treatise *An Inquiry into the Nature and Causes of the Wealth of Nations*, Smith proposed trade based on absolute advantage as an alternative to the mercantilist view prevalent at the time, which advocated stringent state control of international trade plus urged countries to produce as much of everything as possible. He averred that countries should concentrate on the goods and services in which they have an absolute advantage and trade freely with other countries to sell those goods. Thus, a country's resources would be employed optimally, and national wealth would be maximized.

As regards the study objectives, this theory suggests that AGOA should foster trade in products/sectors in which AGOA beneficiaries have absolute advantage. AGOA should lead to an increase in U.S. coffee imports from Uganda since Uganda has an absolute advantage in the production of coffee compared to the U.S. (Torok et al., 2017), if the underlying assumptions of the absolute advantage theory - immobility for factors of production, no barriers to trade, no trade imbalances (deficits, or surpluses) and constant returns to scale - are not violated. However, many of these fundamental assumptions are in fact not true in practice thus casting doubt on the real benefit of AGOA. For example, it may be argued that while AGOA reduces tariffs on many products like coffee, the rules of origin and other applicable product standards it imposes are still forms of trade barriers that could reduce the benefit that Uganda would get from AGOA. Smith's view dominated trade theory until a 19th-century English economist, David Ricardo, advanced the comparative advantage theory.

2.2.1.2. The theory of Comparative Advantage

In his 1817 book: *On the Principles of Political Economy and Taxation*, Ricardo, ascribed the basis and rewards of international trade to the disparities in the comparative opportunity costs of producing the same goods and services among countries. He theorised that, even though one country could produce everything more efficiently than others, it should still trade with others. While this theory offers a simple, strong argument for free trade and specialization among countries, issues get complex when the theory's simplifying premises—one factor of production, a fixed stock of resources, full employment, and a balanced exchange of goods—are replaced by more-realistic parameters.

Nevertheless, as regards the study objectives, this theory suggests that AGOA should foster trade in products/sectors in which parties have comparative advantage, if it is to be of any value. Thus, AGOA should lead to an increase in U.S. coffee imports from Uganda since Uganda has a comparative advantage in the production of coffee compared to the U.S. (Torok et al., 2017). Like Smith, Ricardo bases his theory on the assumption of there being; no barriers to trade, constant returns to scale and no transportation costs. He flips Smith's assumption of immobility for factors of production to the opposite extreme, though in reality, we cannot move factors of production easily. In fact AGOA beneficiaries have been shown to suffer from numerous supply-side factor challenges like land expropriation risks (Deininger & Ali, (2008), Lawry et al., (2016)), distorted product and credit markets, high risk, inadequate social capital and infrastructure and poor public service (Tadesse and Fayissa, 2008), which reduce the mobility of land, labour and capital significantly.

2.2.1.3.The Heckscher-Ohlin (H-O) theory

The aforementioned theories accepted disparities in productivity between countries as given. 20th century international economists offered several explanations as to why countries might have differences in productivity. Fruit of the understanding that countries with abundant factor endowments will generally have a comparative advantage in goods and services employing those endowments, Swedish economists - Eli Heckscher and Bertil Ohlin - put forward the Heckscher-Ohlin (H-O) theory. This theory extended comparative advantage theory by advocating that countries should trade based on their factor endowment. Ohlin's work was an extension of Heckscher's. Ohlin received the Nobel Prize for Economics in 1977 in recognition of his contribution described in his ground-breaking book, *Interregional and International Trade (1933)*.

Contrary to the predictions of this theory, countries with similar endowments, may still find it beneficial to trade with each other as pointed out by the Leontief paradox. The Heckscher-Ohlin (H-O) theory has therefore undergone many refinements over the years to the effect that countries specialization in specific production is not solely dependent on absolute abundance of the factor of production but also on economies of scale and the relative growth rates of countries compared to the rest of the world. Thus, AGOA beneficiaries would need to keep these factors in mind as well. Indeed, this could explain why economically similar countries could enter PTAs with each other.

Under AGOA, the Heckscher-Ohlin (H-O) theory suggests that coffee export would be ideal for Uganda since it is a labour-intensive product and Uganda is relatively more labour endowed (less capital endowed) (Didia, Nica and Yu, 2015), compared to the U.S.. However, this theory is not without its underlying assumptions like; only two factors of production – land and labour, which are fixed but may vary across countries, countries can only produce two goods, production uses constant returns to scale technology and diminishing marginal product, technology for producing one product is more land-intensive than the other, only two countries, perfect competition in markets, producers are price takers, workers get competitive wages and landowners get competitive rent. Often, these might not correspond to reality leading to non-ideal outcomes for U.S. coffee imports from Uganda under AGOA.

2.3. Empirical Review

2.3.1. Factors influencing of coffee imports

Literature is replete with studies on the determinants of coffee exports, however, evidence on the effect of trade preferences on coffee exports from Uganda is non-existent. Tadesse and Fayissa (2008) found that for coffee (HS-09); an increase in the geographic distance between the exporting country and the US resulted in a fall in U.S. imports, depreciation of a SSA country's currency against the U.S. dollar increased U.S. imports of coffee, the stock of immigrants, years elapsed since the first product(s) from each SSA country were exported, plus the lag of the dependent variable were significant and positive, with magnitudes exceeding most other variables in the model. Implying that, with the passage of time, the utilisation of the benefits stipulated by the Act increased as experience was gained from trading eligible product(s).

Blendon et al. (2017), in their critical review of public opinion and President Trump's jobs and trade policies, assert that whereas Republican administrations in the U.S. have generally been more supportive of free trade during the post–World War II era, the current "America First" – U.S. Trade Policy under President Donald Trump might jeopardise non-reciprocal trade agreements like AGOA and reduce U.S. coffee imports from Uganda. Unlike Tadesse and Fayissa (2008), who focus mostly on supply-side factors, the current study incorporates political factors like electioneering and whether the U.S. president is republican or democrat to explore the influence of demand-side factors like politics on U.S. coffee imports from Uganda.

Verter, Bamwesigye, and Darkwah (2015) used OLS regression to show that coffee production and the world price index to be positively related with coffee exports from Uganda using time series data over 1995-2012. These findings were consistent with Gebreyesus (2015), who applied Vector Auto Regression and Error Correction to find the key drivers of coffee export performance in Ethiopia from 1981-2011 and found that the export price of coffee (real), domestic production, physical infrastructure, and world coffee supply significantly affected coffee export supply. In addition, trade openness had only long run effects on coffee export while real exchange rate was statistically insignificant. Though, this could have been due to the fixed exchange regime in Ethiopia.

Hussien (2015), who differed slightly from Gebreyesus (2015), used error correction modelling and found that, in the short run, Ethiopian coffee export supply was determined by the exchange rate (real), inflow of foreign capital, real income and the terms of trade. It was determined by domestic price, exchange rate (real), real income and the terms of trade in the long run. While the above studies offer valuable insights into the product-specific determinants of coffee exports, they do not cater for the effect of trade preferences like AGOA on coffee exports.

ICO (2015) emphasized the importance of the area devoted to coffee growing in East Africa (typically small farms, 0.5 - 10 hectares each), the ageing population of coffee farmers (loss of skilled labour leading to declining farm productivity), plus the fact that coffee is labour intensive and hence costly to produce as being important factors affecting coffee export supply.

UNCTAD (2018) identified several factors affecting coffee exports that are not common in the literature. These include; price volatility (caused by varying yields in the world dominant coffee producing countries plus intense activity in the coffee futures market, used for hedging and speculation - increases risk to vulnerable value chain participants), weather shocks and the general pattern of climate change (such as the damaging frosts in April 1977 – Brazil), the fair-trade social movement ("ethical pricing" which seeks to stabilize producers' incomes by encouraging them to adopt early purchase agreements), as well as rising coffee consumption on the back of new consumption patterns, with booming demand for speciality coffees and certified coffees due to increasing urbanization, a rise in disposable income, the proliferation of coffee shops and the budding of a "café culture".

UNCTAD (2018) also delves into the issue of the gap between producer and retail prices which has enlarged over time and seen a rise in margins for the largest actors, chiefly multinational companies like Nestlé. Growers get the thinnest slice of the pie leading to declining production. While the gap may disincentivise coffee production along the value chain, it has spurred the development of the market for specialty and certified coffees which pay larger premiums to growers. Perhaps strengthening the local coffee market governance structures through cooperatives holds the key to increased bargaining power and access to profitable markets.

The negative effects of climate change are becoming a major determinant of agricultural yield and food security (IPCC, 2019). Most of the world's coffee is produced in the Java/Coffee belt (between the Tropics of Cancer and Capricorn) but consumption is concentrated in the northern hemisphere (UNCTAD, 2018). Further, Robusta is less constrained by environmental conditions but fetches a lower price than Arabica coffee. Epule et al.(2018) studied the effect of non-climatic and climatic variables on crop yields in Uganda using systematic modelling over 1961–2014. They found that forest area dynamics, wood fuel and tractor usage (non-climatic drivers) were more important determinants of crop yields than temperature, precipitation and CO_2 emissions from forest destruction (climatic drivers). Though, climatic drivers exacerbate existing risks on production thus affecting exports. This study will further explore the effect of climatic drivers on coffee exports to the US.

2.3.2. The effect of AGOA on U.S. imports

Much of the empirical literature on analysis of the impact of trade preferences deals with EU's trade preferences (such as the GSP, GSP+, EU-African Caribbean Pacific (ACP) and Everything but Arms (EBA) preferences). Even though AGOA has been in existence for close to two decades, studies on its impact remain largely scanty and findings mixed. Each preference programme is unique. Differences in target and design determine the degree to which beneficiary countries can utilise the preference programme to grow and diversify their trade then improve general welfare. The size and direction of the impact of AGOA varies with the product, degree of disaggregation of exports, period under study, definition of the dependent variable and the method of estimation used (Cooke, 2014).

Using trade data over 1991–2006, Tadesse & Fayissa (2008) found that AGOA led to the start of new and the increase of existing U.S. imports in numerous product categories but not overall. However, compared to its import initiation impact, the import intensification effect of the Act was minimal. Similarly, Frazer and Van Biesebroeck (2010) showed a strong positive impact of AGOA on imports to the US. However, this impact varied with product groups. Apparel and petroleum experienced the biggest impact. Both studies aggregated sub-Saharan countries. This study will go a step further and employ a more disaggregated approach at the product level by focussing on coffee from Uganda alone.

Didia, Nica, and Yu (2015) analysed US imports from 36 SSA countries over a 12 year period and found that AGOA, contrary to Tadesse & Fayissa (2008), had a strong positive and significant impact on US imports based on gravity model estimations. Though, the analysis revealed a disproportionate impact on crude oil exports from SSA's big oil exporters – Angola, Nigeria and Gabon, obviously not the intention of AGOA. These mixed findings show the limitation of such studies, which seek to study the overall picture, at high degrees of aggregation.

Also, Zenebe, Wamisho, Wesley, and Peterson (2015) estimated a gravity model with panel data of US agricultural imports spanning 1990 to 2013, first, with fixed effects to cater for heterogeneity among the countries then with the Heckman sample selection and the Poisson family of models to account for possible biases in sample selection due to presence of zero trade flows in the dependent variable. Their results suggested that AGOA neither had any discernible effect on the value of agricultural exports nor increased the probability of future positive agricultural trade flows from SSA to the US. Though relevant to the current study, these results mask the effects of AGOA on specific products like coffee. This study will seek to address this limitation while focussing on Uganda.

As regards the estimation method used, with the exception of mainly Frazer & Van Biesebroeck (2010), Kassa & Coulibaly (2019) and Fernandes et al. (2019), almost all similar studies use augmented gravity models to identify the influence of PTAs on trade flows (Kassa & Coulibaly, 2019). However, scholars have argued that findings based on the empirical gravity model for estimation may be inaccurate due the challenges it poses in estimating the counter-factual; due to using an inappropriate functional form for estimating PTA impacts using catchall dummies for eligibility that could hide the heterogeneous effects of various non-reciprocal PTAs across countries (Kassa & Coulibaly, 2019). This study will still deploy an augmented gravity model while managing these two pitfalls by firstly taking the case of a single AGOA beneficiary, Uganda (to minimise heterogenous impacts of various PTAs in force), plus have the AGOA dummy take on a value of one for each year Uganda had AGOA exports and zero otherwise as in Didia, Nica, and Yu (2015).

Olarreaga and Özden (2005) analysed the additional margins received by apparel exporters who benefited from AGOA preferences. Their results showed that; exporters received only one-third of the tariff rent; smaller exporters received less than larger, more reputable ones. This evidence suggested that US importers enjoyed a more market power compared to African exporters. The same might not hold for other AGOA eligible products like coffee, fish, minerals and oil hence the need for studies like the present which study AGOA's impact at higher levels of product disaggregation.

Fernandes et al. (2019) recognise that regional studies of AGOA may mask heterogeneity at the country-level. Kassa and Coulibaly (2019) go farther and assert that though *most* countries have seen rises in exports credited to AGOA, these increases have differed by product and country. What's more, that variation in trade effects was mostly was due to country-specific factors, which, as in other spheres of economic enterprise, are essential to understanding the effectiveness of AGOA. This study will determine the effect of AGOA on U.S. coffee import volumes from Uganda, allowing for more nuanced understanding of its effect.

2.3.3. Predicting future U.S. coffee imports from Uganda

Forecasting is key for planning and decision-making in all fields. It entails predicting future conditions and scenarios concerning the issue under study before any decision-making. The third objective of this study is to predict the annual imports of coffee from Uganda into the U.S. from 2019 to 2025 (the foreseeable future under AGOA).

During the last decade several new forecasting techniques have emerged that build on the traditional econometric (time series and regression) models. While prediction science is still a very active and nascent area of research, research is already converging on the superiority of the neural network models as opposed to econometric models.

Using trade data from 1968-2017, Alam (2019) predicted the total annual Saudi trade flows from 2018-2020 and found that forecasted values of total annual exports would fluctuate more in 2020 than in 2014-15. He used both Artificial Neural Networks (ANN) and Autoregressive Integrated Moving Average (ARIMA) models to predict trade flows and found the ANN to be superior.

Dumor and Yao (2019) compared the predictive power of the traditional gravity model with neural networks using bilateral exports data between China and its Belt and Road Initiative (BRI) partner countries from 1990 to 2017. Neural networks predicted 50% of the targets attained for six participating East African countries in the BRI. The prediction for Kenya was 80% on the target.

Using bilateral trade flows among EU15 countries from 1964 - 2003, Nuroğlu (2014) also found that neural networks explained more variation in the bilateral exports compared to panel data analysis. Furthermore, neural networks produced much lower MSE in comparing out-of-sample predictions of the panel model and neural networks, making them superior to the panel model.

In fact, Wohl and Kennedy (2018) based on similar findings from their study of neural network analysis of international trade, proposed five directions for future research; firstly to use neural networks to predict the effects of trade agreements or other trade policies; secondly to further explore how changes in inputs and model architecture affect predictive accuracy; thirdly to apply this same exercise to trade in specific commodities, manufactures, and services, instead of total trade; fourthly to examine more closely why trade between some countries in some commodities, manufactures, and services deviates more from predictions than others and finally to continuously train neural networks using past trade data, generate predictions of future trade, and track the accuracy of such predictions going forward.

This study will contribute to the existing body of literature by mainly taking the third direction proposed by Wohl and Kennedy (2018) to predict U.S. coffee imports from Uganda from 2019 through to 2025, the foreseeable future of AGOA. To the extent that participation in AGOA forms part of the network input variables, this study will also shed some light on the effect of participation in AGOA on imports.

2.4. Research Gaps

The official AGOA strategy document of Uganda, AGOA 101 – UGANDA, leaves a lot to chance in recommending coffee export under AGOA while leaving the deep feasibility analysis to exporters and potential exporters. Further, as observed from the literature review, the exact determinants of the observed heterogeneity of responses to trade preferences remain largely unexplored at the micro-level (country and product level). A product and country specific study of this kind has not yet been done for Uganda. This study hopes to fill this gap in literature by investigating determinants of U.S. coffee import volumes from Uganda under AGOA.

In determining the factors affecting U.S. coffee imports from Uganda under AGOA, this study will also incorporate new variables emerging in more recent literature like climate change. As literature on the effects of climate change continues to develop, this study will likewise contribute to the debate around the long-run effects of climate change on productivity and hence exports of LDCs.

This study would be incomplete, if it remained silent on the U.S. demand outlook for coffee from Uganda. There has been limited application of modern forecasting techniques to trade among LDCs. As illustrated by Wohl and Kennedy (2018), there is need for further application of neural network analysis to international trade. This study will predict future U.S. coffee imports from Uganda for the foreseeable future under AGOA and thus show how policymakers, researchers, and firms can align themselves with these forecasts.

2.5. Conceptual Framework

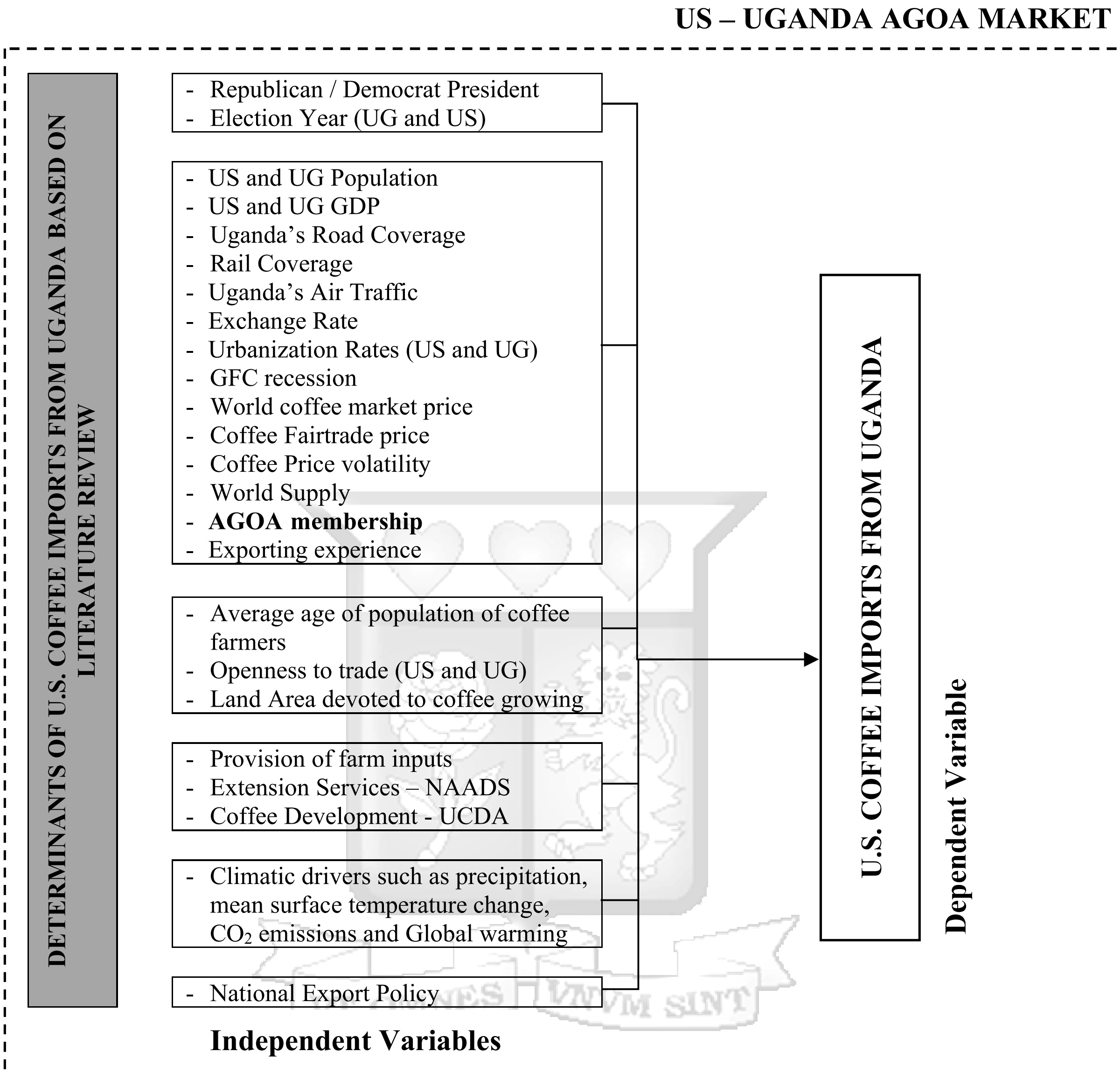


Figure 2.1: Conceptual Framework (Author, 2020)

This framework illustrates the potential relationship between the independent variables (surmised from the literature review) and the U.S. coffee imports from Uganda, the dependent variable.

Chapter 3: Research Methodology

3.1. Introduction

This chapter spells out the proposed techniques to be used in the research. It explains the design, population, sampling techniques, data collection, data analysis procedures, research quality and ethical issues.

3.2. The Research Design

This research followed a longitudinal design. A longitudinal study follows the same sample over time and makes repeated observations then relates the changes in the observations to variables that might explain why the changes occur. Longitudinal research designs describe patterns of change and help establish the direction and magnitude of causal relationships. Longitudinal research designs typically employ panel data, which; facilitates analysis of the duration of a specific phenomenon, enables researchers to approach the kinds of causal explanations derived from field experiments, the description of patterns of change over time, the prediction of future outcomes based upon earlier factors.

In the current study, repeated observations of the import volumes of the same group of coffee products are made annually (1994-2018), changes are tracked over time and related to variables that might explain why the changes occur. The resultant panel data set is also used to predict the U.S. coffee imports from Uganda over the foreseeable future of AGOA.

3.3. Population and Sampling

Out of the entire universe of U.S. imports, this study sampled U.S. coffee imports from Uganda from 1994 to 2018. The corresponding data for the possible determinants of U.S. coffee imports were sampled from various sources as seen under Appendix A. The period 1994-2018 was chosen for completeness of data and to capture both pre- and post-AGOA periods.

3.4. Data Collection Methods

This study used secondary data from various online databases. It was downloaded in MS Excel format after creating the necessary account credentials on the various websites. This process often required filtering to isolate only the data relevant to the period 1994-2018.

All the HS-codes for coffee were obtained from AGOA.info. (2020). Using these codes, the UN Comtrade Database was then queried to find the reported U.S. coffee product imports from Uganda at HS-code level for 1994 to 2018. Though the database provides both the trade value (US$) and net weight (kg) of imports, the dependent variable comprised only of the latter given the challenges associated with the former namely; parity, inflation and base year considerations. Where U.S. imports from Uganda were unreported but data for Uganda's exports to the U.S. was available, the latter was taken as the U.S. imports to minimise instances of missing data.

The rest of the panel (30 possible determinants - independent variables) was sampled (for the same period) from various sources as described under Appendix A.

3.5. Data Analysis

To investigate the determinants of U.S. coffee imports from Uganda under AGOA, the gravity model was used. According to the model: trade between two countries is directly proportional to their individual sizes (GDP), and inversely proportional to the geographic distance between them. That is,

$$M_{ijt} = \left(\frac{GDP_{it}GDP_{jt}}{D_{ij}}\right) \quad \text{……………………………………………..…………………(1)}$$

In its basic form above, the model postulates that country 'i' exports to, or imports M_{ijt} from country 'j' in a given year 't' increase with the joint economic mass of the trading partners (product exporter's GDP_{it} and the importer's GDP_{jt}) but decreases with the distance (D_{ij}) between them, a proxy for transportation cost. Equation (1) above illustrates the theoretical relationship.

The model implies that the higher importer's GDP_{jt} the greater the potential for imports whereas the higher the exporter's GDP_{it} the greater the capacities for export. While higher D_{ij} implies higher transportation costs hence lower bilateral trade.

Since this study only looked at specific products imported by the U.S. from Uganda, the sense of the model was such that M_{ijt} represented the net weight (kg) of eligible product from Uganda (country 'i') imported by the U.S. (country 'j') in a given year 't'.

3.5.1. Empirical Model

Cognizant of the additional factors that affect trade flows, the model given by equation 1 above was augmented with various inhibiting and facilitating variables as spelt out under Appendix A. Then, dropping the $RAIL_{it}$ and T_1 variables for missingness, taking the natural logarithm of the augmented gravity model (continuous variables only) and after performing the relevant diagnostic tests on the remaining set of variables (1 dependent, 30 independent), empirical model was given as equation 2 below:

$$\ln M_{ijt} = \beta_0 + \beta_1 D_2 + \beta_2 D_3 + \beta_3 \text{ fdln } POP_{it} + \beta_4 \text{ fdln } GDP_{it} + \beta_5 \text{ fdln } ROAD_{it} + \beta_6 \text{ fdln } AIR_{it} + \beta_7 \text{ fd}U_{jt} + \beta_8 D_4 + \beta_9 \text{ fdln } E_2 + \beta_{10} \ln E_3 + \beta_{11} AGOA + \beta_{12} S_2 + \beta_{13} \text{ fd}S_3 + \beta_{14} \text{ fdln } S_4 + \beta_{15} X_1 + \beta_{16} \text{ fdln } X_2 + \beta_{17} \ln X_3 + u_{it} + \varepsilon_{it} \quad \text{.......(2)}$$

Of that set of 30 independent variables, only 17 passed the diagnostic tests and were eventually used in the analysis, as seen in equation 2 above. Where GDP_{it} represented Uganda's GDP, POP_{it} represented total Uganda population, $ROAD_{it}$ represented Uganda's road coverage, AIR_{it} represented the extent of Uganda's air traffic, U_{jt} represented the U.S. urbanisation rate. D_2 and D_3 were binary dummies taking a value of 1 for each year in which a presidential election was held in the U.S. and Uganda, respectively; E_2 represented the Fairtrade Foundation minimum coffee price in \$ per pound while E_3 represented standard deviaition of Coffee C Futures Contract in \$ per pound; S_2 represented Uganda's economic openness to trade, S_3 represented U.S.' economic openness to trade and S_4 represented the area harvested (Coffee, green). Lastly, X_1 was a binary dummy taking a value of 1 for each year in which Uganda experienced El Niño[1], X_2 represented the global average long-term atmospheric concentration of carbon dioxide (CO_2) and X_3 represented the mean surface temperature change for Uganda. The coefficient of the "AGOA" dummy variable is expected to capture the effect of implementation of the Act on U.S. coffee imports from Uganda by comparing the post- versus pre-AGOA U.S. coffee import flows from Uganda. "β_0" is the model intercept, "β_k" ($k > 0$) is the coefficient on the k^{th}

[1] Teleconnections phenomena which determine the variation in annual to inter-annual rainfall within the global tropics. According to Uganda's Second National Communication to the UNFCCC (October 2014), Uganda's rainfall varies from 400mm in parts of eastern Karamoja region to 2200mm over Lake Victoria and Mt. Elgon regions (popular for Arabica coffee). Arabica does well in higher and cooler altitudes with rainfall between 1500 and 2000 mm whereas Robusta thrives in lower and warmer areas with close to 2,000 mm per annum. During El Nino, some areas are known to receive upto 100-150% more rainfall. El Nino is often equated to floods. Floods affect the quality of coffee through various channels.

independent variable, the "fd" prefix connotes a first difference, u_{it} is the between entity-error and ε_{it} is the within entity-error. Appendix A gives a further elaboration on the variables.

To address objective one, equation 2 was estimated by running a panel regression of the dependent variable (U.S. coffee imports from Uganda) on the independent variables. The main determinants of U.S. coffee imports from Uganda under AGOA were those independent variables whose coefficients were significant at 5%, that is, had a p-value < 0.05. To decide between fixed or random effects a Hausman Test was run where the null hypothesis is that the preferred model is random effects vs. the alternative the fixed effects. To address objective two, the sign and size of the coefficient on the "AGOA" variable indicated the effect of AGOA on U.S. coffee imports from Uganda. The data used to address objective one and two is provided under Appendix B.

3.5.2. Artificial Neural Network Analysis

To address objective three, this study used simple Artificial Neural Network (ANN) analysis to predict the foreseeable U.S. coffee imports from Uganda under AGOA. The analysis was performed using R. Since the goal was to predict total U.S. coffee imports from Uganda between 2019-2025, the coffee imports were summed up to find the totals for each year from 1994-2018, a total of 25 observations (30 independent variables). This data set, provided under Appendix C, was used to train and fit the ANN. Since ANNs capture the intrinsic information from the variables under consideration and learn from them, even in the presence of noise, no a priori model is needed (Baxter and Srisaeng, 2018).

Artificial neural networks (ANNs) are computer programs constructed to simulate the workings of the human brain as it processes information. They are formed from numerous single units, artificial neurons or processing elements (PE), linked with coefficients (weights), which comprise the network structure and are organised in layers (Baxter and Srisaeng, 2018).

The strength of neural computations is derived from linking neurons in a network. Each PE weights inputs, has a transfer function and gives one output. The transfer functions of a network's neurons, the learning rule, and architecture determine the behaviour of a neural network. When the weighed sum of the inputs ("activation of the neuron") reaches some pre-set threshold, the neuron is activated, an activation signal is passed through its transfer function and produces a single output. The transfer function embedded in each neuron determines whether it should be activated, based on how relevant each neuron's input is for the model's prediction.

A neural network is optimized (trained) by altering the parameters and assessing the effect of such alterations using the sole criteria of whether it makes the predicted value of the dependent variable more or less accurate. The training process is demonstrated by figure 3.1 below.

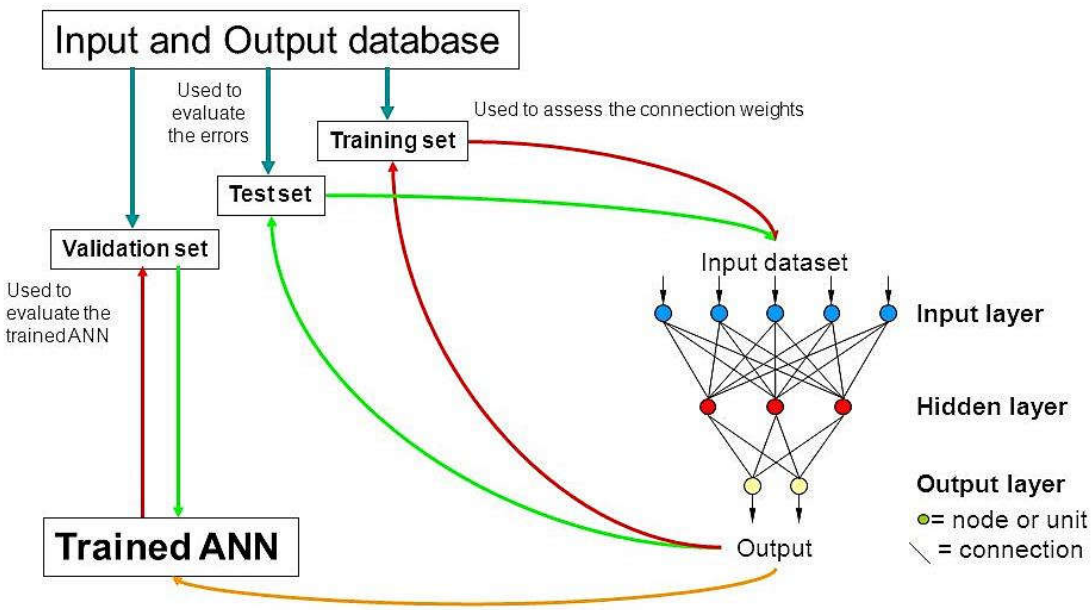


Figure 3.1: Illustration of Artificial Neural Network Training (Source, Google Images)

To predict the future U. S. coffee imports, the panel dataset was randomly divided into a 70:30 ratio, that is, a training set and a test set. To determine the finish point for the training, the ANN was validated using the k-fold cross-validation approach.

The validated ANN model with a lower Root Mean Square Error (RMSE) was chosen. The RMSE was computed as the square root of the average of squared errors between the predicted values and the actual values:

$$RMSE = \sqrt{\sum_{i=1}^{n} \frac{(\hat{y}_i - y_i)^2}{n}}$$

Where: $\hat{y}_i$ was predicted and y_i was observed and n was the number of observations

The independent variables were extrapolated for the foreseeable future of AGOA and used to predict the corresponding future U.S. coffee import volumes from Uganda. To compare accuracy of the prediction, the results of the gravity model-based prediction (Equation 2) were compared with those of the neural network.

3.6. Research Quality – validity, reliability and objectivity of the research

According to Baltagi (2005), cross-sectional dependence is a problem in macro panels with long time series (over 20-30 years). Given this study's panel spans 25 years, a test for cross-sectional dependence/contemporaneous correlation was performed using the Breusch Pagan LM test of independence to be sure that that residuals across entities were not correlated. Also, as appropriate, Diagnostic tests for heteroskedasticity and serial correlation were performed. To ensure that the above regression was not spurious, tests for stationarity were performed using the Augmented Dickey Fuller test.

3.7. Ethical Issues in Research

In order to address any ethical issues that may arise during this study, the researcher abided by the Code of Ethics of Strathmore University and ensured that the proposed research was approved by the Internal Review Board of the University plus the National Commission for Science, Technology and Innovation (NACOSTI). To address data confidentiality and access concerns, this research made use of publicly available secondary data sets from various online portals. Where access required online registration, the researcher created the necessary online access accounts to legally obtain the data. The data sets were only used for academic research purposes. No human subjects were required for this study.

Chapter 4: Presentation of Research Findings

4.1. Introduction

This chapter presents the research findings. First, a summary and description of the study variables, descriptive statistics, followed by diagnostic tests, the panel regression and finally the neural network analysis results. Objective one and two were answered in section 4.4.4 and 4.4.5 respectively whereas objective three was answered in section 4.5.1. All the analysis was performed using R software.

4.2. Summary and Description of the Study Variables

An unbalanced panel: n = 7, T = 1-24, N = 76 (Appendix B) was used for this study. It comprised of one (1) dependent variable (U.S. Coffee imports from Uganda – M_{ijt}) and seventeen (17) independent variables. Table 4.1 below shows brief descriptive statistics (pre- and post-AGOA) of U.S. coffee imports from each Uganda (by product), the dependent variable.

Table 4.1: Pre- and Post-AGOA average annual U.S. coffee imports from Uganda

Dependent Variable	**Pre-AGOA (1994-2000)**		**Post-AGOA (2001-2018)**	
	Mean (St. Dev.)	**% (Total)**	**Mean (St. Dev.)**	**% (Total)**
Imports (090111)	8,443.85 (3,789.58)	96.48	7,127.56 (2,640.30)	90.04
Imports (090112)	297.49 (158.07)	3.40	719.00 (981.91)	9.08
Imports (090121)	75.03 (-)	0.12	4.69 (6.27)	0.04
Imports (090122)	- (-)	0.00	254.98 (290.06)	0.54
Imports (090190)	- (-)	0.00	43.25 (84.81)	0.30
Imports (210111)	- (-)	0.00	0.56 (-)	0.00
Imports (210112)	1.50 (-)	0.00	0.68 (-)	0.00
Total Imports	**3,829.12 (3,814.72)**	**100**	**2,298.20 (3,306.22)**	**100**

According to the Harmonized Commodity Description and Coding Systems (HS)[2], product 090111 is coffee, not roasted, not decaffeinated; 090112 is coffee, not roasted but decaffeinated; 090121 is coffee, roasted but not decaffeinated; 090122 is coffee, roasted and

[2] Is an international nomenclature for classifying products. At the international level, a six-digit code is used for classifying goods per the Harmonized System (HS). (Source: UN ITS Knowledgebase)

decaffeinated; 090190 is coffee husks and skins + coffee substitutes containing coffee; 210111 is instant coffee + extracts, essences and concentrates of coffee (flavoured and non-flavoured); while 210112 is preparations + syrups (with a basis of coffee or its extracts, essences or concentrates).

Table 4.1 makes some interesting suggestions. On average, the annual tonnage of U.S. coffee imports from Uganda reduced from 3,829.12 pre-AGOA to 2,298.20 post-AGOA but the variety of coffee products imported from Uganda increased. Coffee, not roasted, not decaffeinated (090111) dominated U.S. coffee imports from Uganda throughout the period under study. The descriptive statistics for selected independent variables were as follows;

Table 4.2: Pre- and Post-AGOA descriptives for 17 selected independent variables

Independent Variables	**Pre-AGOA (1994-2000)**	**Post-AGOA (2001-2018)**
	Mean (St. Dev.)	**Mean (St. Dev.)**
U.S. Presidential Election (D_2)	0.29	0.22
UG Presidential Election (D_3)	0.14	0.22
UG Total Population (POP_{it})	21.68 (1.38)	32.49 (5.67)
Uganda's GDP (GDP_{it})	5.83 (0.85)	17.22 (8.21)
Uganda's Road Coverage ($ROAD_{it}$)	2,312 (171.19)	3,290 (609.44)
Uganda's Air Traffic (AIR_{it})	1,195 (872.52)	2,688 (2,856.07)
U.S. Urbanisation Rate (U_{jt})	1.64 (0.07)	1.04 (0.11)
GFC Recession (D_4)	0	0.22
Coffee Fairtrade Price (E_2)	1.20 (0.02)	1.30 (0.09)
Coffee Price Volatility (E_3)	0.24 (0.16)	0.13 (0.07)
AGOA membership (AGOA)	0	1
UG Openness to Trade (S_2)	29.90 (1.91)	33.28 (4.47)
U.S. Openness to Trade (S_3)	18.11 (1.02)	20.86 (2.18)
Area farmed with coffee (S_4)	274.14 (13.49)	317.68 (65.34)
Precipitation (X_1)	0.29	0.17
Global CO_2 emissions (X_2)	364.37 (3.98)	389.28 (11.60)
Mean Surface Temp. Change (X_3)	0.43 (0.17)	0.99 (0.33)

Table 4.2 above suggests that, on average, 7% less time was spent electioneering in the U.S. post-AGOA while the reverse was true for Uganda. The U.S. was in recession 22% of the post-AGOA time due to the GFC (2007-2010). The Fairtrade price increased, world coffee price volatility reduced and both countries were more open to trade post-AGOA. Uganda experienced less El Niño on average post-AGOA, but global CO_2 emissions and the mean surface temperature of Uganda rose.

4.3. Results of diagnostic tests

The continuous variables, except for rates (%), were transformed to natural logarithms before diagnostic tests were performed. Several diagnostic tests were performed. First, tests for stationarity of all variables, then multicollinearity. Other diagnostic tests for cross-sectional dependence, serial correlation (autocorrelation), heteroskedasticity and the normality of residuals were performed on the selected model.

4.3.1. Stationarity

Presence of a unit root (non-stationarity) in a series indicates that more than one trend exists in the series. Hence, its properties will depend on the time at which the series is observed. Using variables that are non-stationary may lead one's regressions to be spurious. To address stationarity in the data, all the transformed variables were subjected to a stationarity test using the augmented Dickey Fuller Test. The first differences of the non-stationary variables were tested and found to be stationary. They were hence adopted for modelling. Variables whose first differences were used for the regression carried the "fd" prefix as can be seen in table 4.3 below, that is, ln POP_{it} (Uganda population), ln GDP_{it} (Uganda's GDP), ln $ROAD_{it}$ (road coverage), ln AIR_{it} (Uganda's Air Traffic), U_{jt} (U.S. urbanisation rate), ln E_2 (Fairtrade Foundation minimum coffee price), S_3 (U.S.' economic openness to trade), ln S_4 (area harvested) and ln X_2 (global CO_2 emissions).

4.3.2. Multicollinearity

Multicollinearity refers to a situation in which at least two predictor variables are correlated/collinear. It becomes a 'problem' when this association exceeds a certain limit or degree, usually set at a Variance Inflation Factor (VIF) of 10. Several predictor variables were progressively dropped by checking the VIF progressively using *vif()*, *vifcor()* with a pairwise correlation threshold of 0.90 and *vifstep()* with a VIF threshold of 10 from the *usdm* package in R. This exercise leaves only 17 independent variables each with a VIF < 5 and pairwise correlation ranging between 0.002 and 0.558.

4.4. Results of panel model estimation

4.4.1. Fixed effects vs. OLS

To select between a simple OLS regression and the fixed effects models, the models were subjected to the *pF test* (F test for individual effects) which returned a p-value < 0.05, leading to a rejection of the test's null hypothesis (no individual effects) thus indicating that fixed effects model was a better choice than the OLS. The fixed effects model assumes that the difference across products is fixed and correlated with the independent variables included in the model. However, there no reason why this variation cannot be random and uncorrelated with the predictor variables. To clarify this, a random effects model was estimated and tested against the fixed effects model.

4.4.2. Fixed effects vs. Random effects

A random effects model was then fitted to the panel data. To choose between fixed or random effects a Hausman test was run where the null hypothesis is that the unique errors are not correlated with the regressors (the preferred model is random effects). The test returned a p-value > 0.05 indicating that the random effects model should be used instead.

To further rule out time-fixed effects, a time-fixed effects model was compared to the fixed effects model above using the *pF test*. Th test returned a p-value > 0.05 leading to a failure to reject the test's null hypothesis (no time-fixed effects) thus indicating that the fixed effects model (already shown to be inferior to the random effects, for this study) was a better choice compared to the time-fixed model.

To choose between a random effects' regression and the simple OLS regression. The Breusch-Pagan Lagrange multiplier (LM) test for random effects was run. It returned a p-value < 0.05 leading to a rejection of the test's null hypothesis (variances across entities is zero), indicating that the data in fact exhibited a panel effect and therefore the random effects model was more appropriate.

4.4.3. Results of random effects panel regression

The results, with Standard Errors (SEs) in parentheses below estimated coefficients, were as follows:

Table 4.3: Random effects regression model results (Dependent Variable, **ln.M_{ijt}**)

	Using Robust SEs
Intercept (β_0)	2.524
	(3.688)
U.S. Presidential Election (D_2)	0.153
	(0.487)
UG. Presidential Election (D_3)	- 0.825
	(0.601)
UG. Total Population (fdln POP_{it})	- 43.309
	(127.510)
Uganda's GDP (fdln GDP_{it})	- 1.367
	(0.857)
Uganda's Road Coverage (fdln $ROAD_{it}$)	24.752
	(14.939)
Uganda's Air Traffic (fdln AIR_{it})	0.215 *
	(0.090)
U.S. Urbanisation Rate (fdU_{jt})	- 4.903
	(2.478)
GFC Recession (D_4)	- 0.709
	(0.753)
Coffee Fairtrade Price (fdln E_2)	- 3.525
	(1.983)
Coffee Price Volatility (ln E_3)	- 0.385
	(0.633)
AGOA membership (AGOA)	- 2.476 *
	(1.201)
UG Openness to Trade (S_2)	0.130
	(0.095)
U.S. Openness to Trade (fdS_3)	0.229 *
	(0.105)
Area farmed with coffee (fdln S_4)	- 1.367
	(2.846)
Precipitation (X_1)	- 0.276
	(0.595)
Global CO_2 emissions (fdln X_2)	- 274.848 *
	(133.261)
Uganda's Mean Surface Temperature Change (ln X_3)	1.894 *
	(0.890)
Goodness of Fit statistics:	
n	7
T	1-24
N	76
R squared	0.280
Adj R squared	0.068
Chisq	21.618
P-value	0.200

***** p < 0.001; ** p < 0.01; * p < 0.05**

4.4.4. The main factors influencing U.S. coffee import volumes from Uganda

Of the 17 variables in table 4.2 above, only 5 showed statistically significant relationships at 5% level of significance with U.S. coffee imports from Uganda as seen from the results in table 4.3 above, namely; air traffic (AIR_{it}), AGOA membership (AGOA), U.S. openness to trade (S_3), global CO_2 emissions (X_2) and the mean surface temperature change for Uganda (X_3). All had negative relationships with U.S. coffee imports from Uganda except air traffic and mean surface temperature change. These 5 variables are the main factors influencing U.S. coffee import volumes from Uganda as required by objective one of this study. This result is explored further in the discussions of chapter 5.

Most other coefficients in table 4.3 above, though not statistically significant, bore the expected signs. Increase in Uganda's openness to trade (S_2) and its road coverage ($ROAD_{it}$) were positively related with increase in U.S. coffee imports. The GFC experience (D_4) and increase in coffee price volatility (E_3) were negatively related with U.S. coffee imports. Presidential electioneering in Uganda (D_3) was negatively related with U.S. coffee imports whereas the reverse was true for presidential electioneering in the U.S. (D_2).

The rest of the variables, except for X_1 (experience of El Niño), were not statistically significant. In addition, their coefficients bore unexpected negative signs indicating a negative relationship with U.S. coffee imports from Uganda.

4.4.5. The effect of AGOA on U.S. coffee import volumes from Uganda

Adresssing objective two, the regression results in table 4.3 above show that AGOA membership has a negative effect on U.S. coffee imports from Uganda. Each additional year under AGOA was associated with a 91.596%[3] reduction in U.S coffee imports from Uganda. This result is explored further in the discussions of chapter 5.

4.4.6. Further random effects model reliability diagnostics

Cross-sectional dependence means that the residuals across products are correlated, which could lead to biased tests results. To test for cross-sectional dependence, the Breusch-Pagan LM test for cross-sectional dependence in panels was run on the random effects model. It

[3] Computed as $\%\Delta M_{ijt} = 100*(e^{(-2.476)}-1) = -91.596\%$

returned a p-value > 0.05 leading to failure to reject the test's null hypothesis that the residuals across entities were not correlated (no cross-sectional dependence).

Serial correlation may occur within and across cross-sections. Tests typically apply to long series panels (over 20-30 years) according to Torres-Reyna (2020). Serial correlation makes the standard errors of the coefficient estimates smaller than they actually are and leads to a higher R-squared. To test for serial correlation, the Breusch-Godfrey/Wooldridge test for serial correlation in panel models was run on the random effects model. It returned a p-value < 0.05 leading to a rejection the test's null hypothesis (there is no serial correlation). Standard errors were clustered by group to account for serial correlation. This was implemented through the *vcovHC* function in R, plm package (Croissant et al., 2020).

While heteroscedasticity does not cause bias in the coefficient estimates, it does make them less precise. Heteroscedasticity tends to produce p-values that are smaller than they should be leading one to conclude that a model term is statistically significant when it is not significant. To test for heteroskedasticity, the Breusch-Pagan test for the presence of heteroskedasticity was run on the random effects model. It returned a p-value < 0.05 leading to a rejection the test's null hypothesis (homoskedasticity (no heteroskedasticity)). As seen in Table 4.3, robust Standard Errors (SEs) were used to correct for heteroskedasticity. This was also implemented through the *vcovHC* function in R, plm package (Croissant et al., 2020).

Though it is not required that the residuals (error terms) follow a normal distribution to produce unbiased estimates with the minimum variance, normality of the residuals after modelling, guarantees the reliability of the p-values for hypothesis testing on the estimated coefficients and the overall test of significance. To test for normality of the residuals, the Jarque-Bera Test for normality was run on the residuals of the random effects model. It returned a p-value > 0.05 leading to a failure to reject the test's null hypothesis (normality of the residuals).

4.5. Results of Artificial Neural Network (ANN) analysis

To address objective three, the dataset of 25 observations of total U.S. coffee imports from Uganda (output variable) over the 25-year period from 1994-2018 together with the thirty (30) independent variables (input variables) as under Appendix C was used. The ANN was constructed using the *neuralnet* function from the *neuralnet* package in R.

The observations were divided into a training and test set. The training set to capture the relationship between dependent and independent variables and the test set to assess the performance of the model. 70% of the dataset formed the training set. The assignment of the data to training and test set was done using random sampling with the *sample()* function and *set.seed()* to generate same random sample every time and maintain consistency. The dataset was scaled before fitting the neural network using the min-max method, which retains the original distribution of the variables.

The selected network consisted of one (1) hidden layer and nine (9) neurons as plotted in figure 4.2 below. Out of all possible network models, It was selected because it had the lowest; train error (0.00094), steps required for convergence (137), test error (RMSE = 2,753.892 tonnes) and met the performance resilience characteristics for out-of-sample prediction as illustrated by figure 4.1 below, that is, the median RMSE was calculated and shown to reduce with increasing size of the training set hence the robustness (accuracy) of the model increases when training sets are large.

Using the test set data, the U.S. coffee imports from Uganda (M_{ijt}) were predicted using the neural network model and compared with actual U.S coffee imports from the test set. The test error (RMSE) was 2,753.892 tonnes. However, the RMSE, which is a residual method of evaluation, does not tell us about the behaviour of our model when out-of-sample data is introduced. So, before using the model for out-of-sample prediction (U.S. coffee imports from Uganda from 2019-2025), it was validated for robustness using the k-fold cross-validation approach.

K-fold cross-validation involved iterating the model on validation sets generated from the original 25 observations whose number of elements varied from 5 to 20, selecting 100 samples (validation sets) randomly for each number of elements. That is, 100 sets with 5 elements each, 100 sets with 6 elements each, 100 with 7 and so on till 100 with 20, at total of 1,600 validation sets. The variation of the median RMSE with length of the training set from this validation exercise was plotted in figure 4.1 below. This downward slope signals the robustness of the neural network model as explained by Basalamah (2019) and Hou (2018).

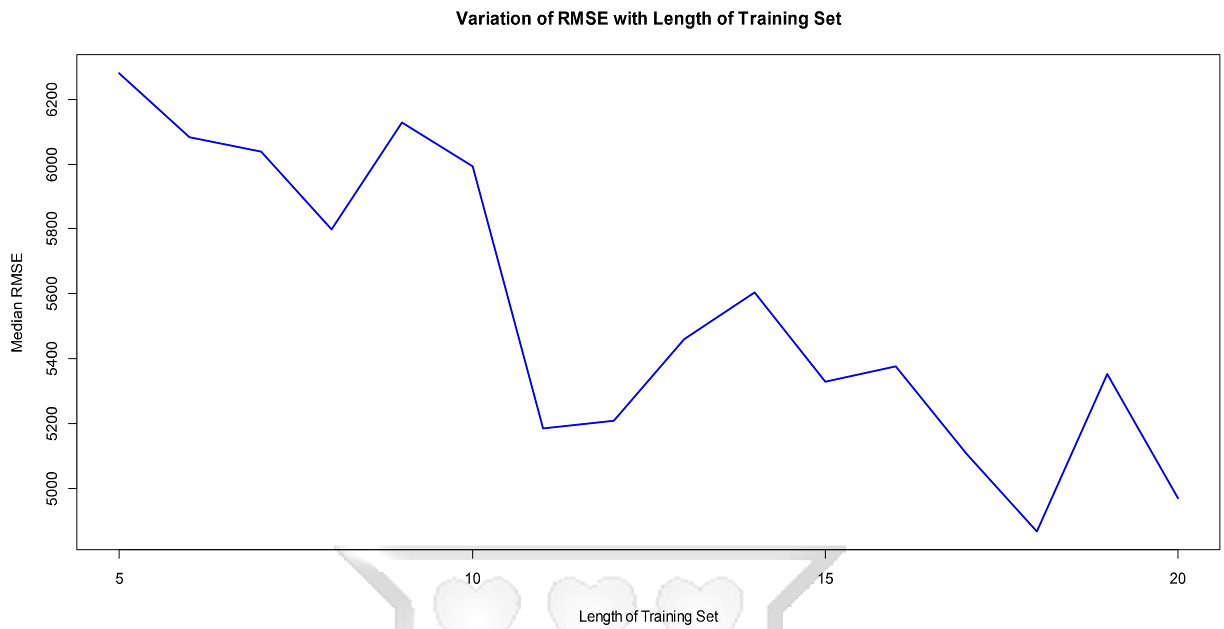


Figure 4.1: Performance resilience of the neural network model

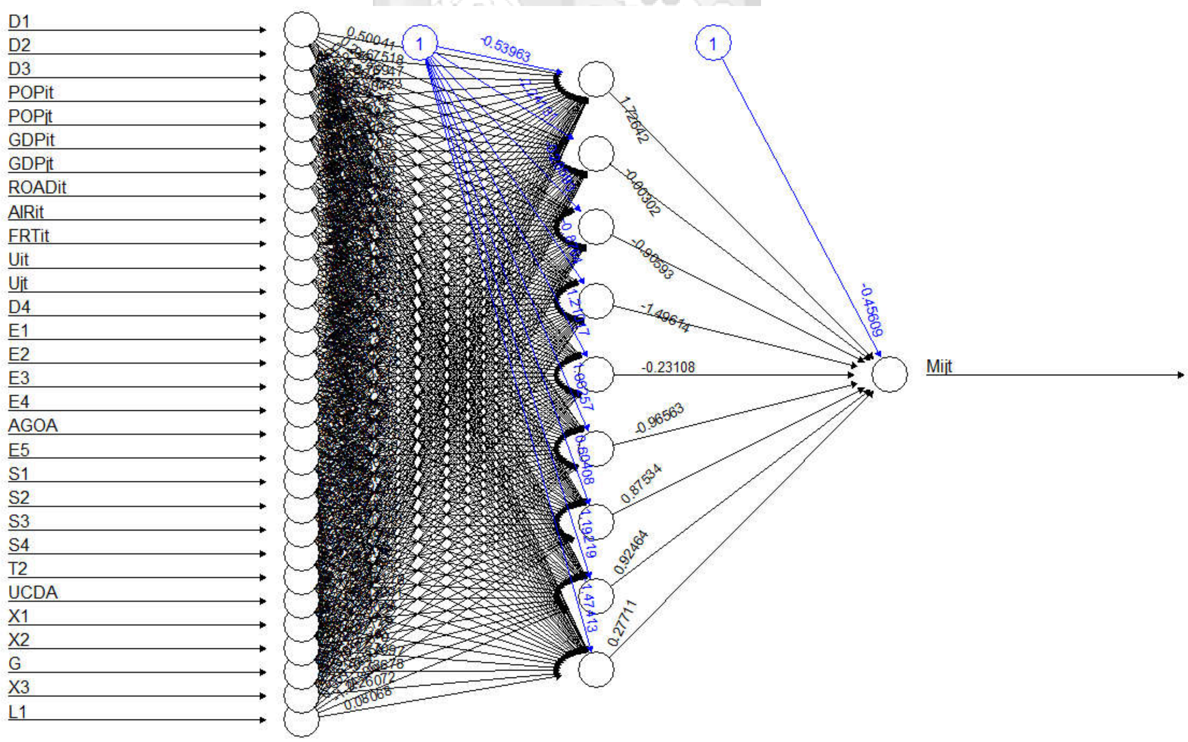


Figure 4.2: Artificial Neural Network (Error: 0.00094, Steps: 137)

4.5.1. Future U.S. coffee import volumes from Uganda under AGOA

In answer to objective three of this study, table 4.4 below shows the predicted U.S coffee imports from Uganda for the period 2019-2025 for both the random effects model and the neural network model.

Table 4.4: Predicted U.S. Coffee imports from Uganda (2019-2025)

Predicted Values (tonnes)			
	Random effects model (RSME: 344.86)		ANN (RSME: 2753.892)
	ln.M_{ijt}	**M_{ijt}**	**M_{ijt}**
2019	-1612.624	0	0.073
2020	-1614.057	0	0.439
2021	-1616.603	0	0.579
2022	-1614.851	0	347.413
2023	-1616.385	0	46.609
2024	-1617.748	0	23,647.700
2025	-1621.878	0	33.292

Despite its larger RMSE, the neural network model seems to outperform the random effects model which reports nil future U.S. coffee imports from Uganda. A quick inspection of the results shows that the neural network predicts an upward trend in imports as required to answer objective three.

Chapter 5: Discussions, Conclusions and Recommendations

5.1. Introduction

This chapter discusses the findings presented in the previous chapter in accordance with the research objectives. It highlights this study's contribution to the body of knowledge and cites its limitations then draws conclusions and makes recommendations for firms, policy and further research.

5.2. Discussions

5.2.1. The main factors influencing U.S. coffee import volumes from Uganda

The regression results in table 4.3 show that the main factors influencing U.S. coffee import volumes from Uganda as required by objective one of this study are; air traffic (AIR_{it}), U.S. openness to trade (S_3), global CO_2 emissions (X_2), the mean surface temperature change for Uganda (X_3) and AGOA membership (AGOA).

A 1% increase in the number of registered carrier departures from Uganda (AIR_{it}) was associated with a 0.215% increase in the U.S coffee imports from Uganda. Even though most coffee exports from Uganda are carried by road then shipped to processors (ITC, 2012), this finding is consistent with the gravity model theory that reducing the distance between trade partners increases trade between them (Tadesse and Fayissa, 2008). Air transport carries many of the big deals and contracts that keep the coffee industry alive. A 1% increase in the U.S.' openness to trade (S_3) was associated with a 25.780%[4] rise in U.S coffee imports from Uganda indicative of the bearing of infrastructure and open trade policy on closing the distance between trade partners. In fact, increased transport and openness support the assumptions of no barriers to trade, perfect mobility of factors of production and perfect competition under the comparative advantage and Heckscher-Ohlin theories.

Consistent with UNCTAD (2018) on the negative impacts of climate change though still curious for the size of its effect, a 1% increase in global average long-term atmospheric concentration of carbon dioxide (CO_2) in parts per million (ppm) (X_2) was shown to be

[4] Computed as $\%\Delta M_{ijt} = 100*(e^{(0.229)}-1) = 25.780\%$

associated with a 274.848% decrease in U.S. coffee imports from Uganda. While a 1% increase in the mean surface temperature change for Uganda (X_3) was shown to be associated with a 1.894% rise in U.S. coffee imports from Uganda. Relatedly, though not significant, the experience of El Niño (X_1) was negatively related with U.S. coffee imports.

Rainfall and temperature conditions are the key drivers of coffee yield (ITC, 2020). Arabica and Robusta have different requirements. Temperatures in the coffee/java belt vary between 13 – 26°C, mostly conducive for Robusta coffee. Coffee also needs shade throughout its growth phase, regular rain and sun when fruits start to appear. (UNCTAD, 2018). Rising temperatures and climate change in general could have either positive or negative effects or both on the quality of coffee according to Pham et al. (2019).

Global CO_2 emissions impact coffee trade through global warming. Currently, fresh air contains between 0.036% (360 ppm) to 0.041% (412 ppm) CO_2, depending on one's location. Before the Industrial Revolution (mid-1700s), the carbon dioxide was at about 280 ppm (Eggleton, 2013). This means that CO_2 content in fresh air has increased by 28.6% over about three centuries and resulted in an increase in global temperatures by between 0.8 – 1.2ºC (IPCC, 2018). Global warming increases the risk of droughts and floods, the severity of El Niño (Wang et al., 2019) plus other adverse changes in climate. It is not surprising, therefore, that a 1% change in the global average long-term atmospheric concentration of carbon dioxide (CO_2) in parts per million (ppm) (X_2) is associated with such a massive negative effect on U.S. coffee imports (mostly Arabica), also seeing as it would be a 1% change in a single year. This negative relationship was consistent with several prior studies as reviewed by Legesse (2019).

Uganda's geo-location (along the Equator) means that its temperatures are largely determined by heat from the Earth's surface (Nsubuga & Rautenbach, 2018). Most other studies point to a negative relationship between temperature and coffee production, especially Arabica which prefers cooler altitudes. Therefore, the positive and significant coefficient on X_3 could perhaps be because Uganda's mean surface temperature remained well within the above band, 23.6°C on average over the study period according to data from the World Bank database. Or, it could be due to the adoption of improved coffee varieties (Mulinde et al., 2019) plus better farming practices such as adding shade in the coffee systems to reduce temperatures (Jassogne et al., 2013), a common practice in Uganda. Regarding the trade theories in chapter 2, favourable climate enhances the viability of the factors of production. This is especially relevant to the Heckscher-Ohlin theory which predicts that countries with abundant factor endowments will generally have a comparative advantage in goods and services employing those endowments.

Most other coefficients in table 4.3, though not significant, bore the expected signs. Increase in Uganda's openness to trade (S_2) and its road coverage ($ROAD_{it}$) were positively related with increase in U.S. coffee imports. The GFC experience (D_4) and increase in coffee price volatility (E_3) were negatively related with U.S. coffee imports. Presidential electioneering in Uganda (D_3) was negatively related with U.S. coffee imports whereas the reverse was true for presidential electioneering in the U.S. (D_2).

Increasing population (POP_{it}) and income growth (GDP_{it}) in Uganda were negatively related with U.S coffee imports, a counterintuitive result going by the findings of most studies. However, using Africa-wide case study evidence, Bryceson & Jamal (2019) showed that this negative association could be a result of more members of smallholder households opting for non-agrarian livelihoods and moving to urban areas. Aging farmers have also left behind mostly unskilled young farmers all too skeptical about commercial agriculture (FAO, 2014). Additionally, as more small holder family members migrate to urban centres, smallholder farmers must hire more workers to care for their farms, further increasing the cost of production (UNCTAD, 2018). This explanation also ties in with the predictions of the Heckscher-Ohlin theory. As labour becomes scarce, Uganda would lose its comparative advantage in coffee as coffee is particularly labour-intensive. U.S imports of coffee from Uganda would be expected decline as a result, ceteris paribus.

Sustainability standards such as Fair Trade (FT) or Utz certified are generally seen as a way of improving the welfare of smallholder coffee farmers but the impact of certification remains largely unexplored (Ruben & Hoebink, 2015). Fairtrade minimum pricing reduces the coffee consumers' surplus (Naegele, 2019). Standard economic theory suggests that rising prices will lessen demand, ceteris paribus. This would explain the negative coefficient on the coffee Fairtrade trade price (E_2), which perhaps reflects the reluctance of U.S. customers to take lower margins on coffee imports from Uganda, perceived to be of a relatively lower quality compared to competitors, partly due to poor branding and marketing (Morjaria & Sprott, 2018). In fact, Hainmueller et al. (2014) find that while consumers attach value to ethical coffee, their willingness to pay for it varied. Indeed, certification may be barrier to trade, which would violate a key assumption for all the trade theories in chapter 2 and cast doubt on the predicted benefits of coffee trade under AGOA. Related to this, the negative coefficient on the farmed area for coffee (S_4) runs contrary to the H-O factor endowment advantage theory suggesting the probable presence of farm productivity issues (like aging coffee farmers, trees that may require replanting or rejuvenation) and other value-chain factors that could reduce yields, compromise quality and dampen demand for Uganda's coffee in the international market (ITC, 2016).

Lastly, one would expect that increasing urbanisation rates in the U.S. would lead to higher disposable incomes which, combined with the spread of coffee shops and the budding "café culture" according to UNCTAD (2018), would lead to an increase in U.S. coffee imports from Uganda. However, the negative coefficient of the U.S. urbanisation rate (U_{jt}) suggests otherwise. One possible explanation for this is the fact that U.S. urbanisation rates were approximately 37% lower on average post-AGOA (see table 4.2). This explanation agrees with standard economic theory, which would suggest that decreasing urbanisation would lead to a drop in demand for coffee in urban areas.

5.2.2. The effect of AGOA on U.S. coffee import volumes from Uganda

The regression results for AGOA membership were negative, significant and surprising; each additional year under AGOA was associated with a 91.596% reduction in U.S coffee imports from Uganda. This result contradicts standard trade theory which would dictate that Uganda would benefit from AGOA membership by virtue of its comparative and factor endowment advantage in relation to coffee. These theories neither accounted for competition between Uganda and other coffee exporters for U.S. coffee markets nor Uganda's structural and technology disadvantages plus the split nature of the coffee value chain.

According to numerous periodic reports of the Uganda Coffee Development Authority (UCDA), green arabica coffee constituted the bulk of U.S. coffee imports from Uganda. Consistent with the hope enshrined in the African Growth and Opportunity Act, 2000

(AGOA) that LDCs will 'learn by doing' and over time elevate the sophistication of their products, expand into other goods and markets, and eventually outgrow the need for preferences; AGOA-status was granted to the 090190 and 210112 classes which comprise of more sophisticated processed coffee products as opposed to the less sophisticated coffee products (090111, 090112, 909121, 090122 and 210111). However, 090111 dominated U.S. coffee imports from Uganda throughout the period under study even though the average annual tonnage of product 090111 imported by the U.S. from Uganda declined by about 6.5% post-AGOA (see Table 4.1).

Both Tadesse & Fayissa (2008) as well as Frazer and Van Biesebroeck (2010) found that AGOA membership had different effects on different products. Therefore, the observed negative relationship was consistent with their findings. In fact the possibility of such different effects by products as opposed to overall imports as expressed by Kassa & Coulibaly (2019) formed one of the motivations for this study. Perhaps the relationship could turn positive by 2025 and beyond, If Uganda keeps its post-AGOA momentum by entering into the market for more sophisticated coffee product lines to utilise the benefits stipulated by AGOA.

5.2.3. Future U.S. coffee import volumes from Uganda under AGOA

The ANN model outperforms the random effects model at predicting out-of-sample future U.S. coffee imports from Uganda under AGOA. A quick inspection of the results under table 4.3 reveal that future U.S. coffee imports from Uganda are expected to be somewhat erratic but still trend upwards. This is consistent with the positive U.S. coffee demand projections of the USDA Foreign Agricultural Service (2019a), Voora et al., (2019) and Mordor Intelligence (2020). In fact, Global coffee consumption is predicted to get to 300 million bags by 2050 according to the International Trade Centre (ITC, 2020a).

5.3. Conclusions

Based on the findings of this study, the main factors influencing the volume of U.S. coffee imports from Uganda were; air traffic, AGOA membership, U.S. openness to trade and climatic factors like global CO_2 emissions (global warming) and the mean surface temperature in Uganda. Other more country specific issues like electioneering could also affect U.S. coffee imports. AGOA was shown to have had a negative effect on U.S. coffee imports from Uganda, however, the variety of coffee products imported by the U.S. from Uganda seem to have increased. U.S. coffee imports from Uganda are expected to be somewhat erratic between 2019-2025 but still trend upwards.

5.4. Recommendations

Should exporters or potential exporters decide to get into coffee export to the U.S. under AGOA, it would be most profitable to focus on sophisticated coffee products within the product classes granted AGOA status. While green coffee would be the easiest to export, it currently fetches the lowest price on the international market (UNCTAD, 2018). Firms should pay attention to the main determinants especially climatic factors as they could have significant impact on the volume and quality of coffee produced. This study also highlights the importance of value and supply chain activities between the farm and market. Firms will need to take a more active role in the process to ensure they receive a high-quality coffee product.

To accelerate a move towards a more sophisticated, higher value and competitive coffee product and industry, policy makers should accelerate quality, branding and marketing interventions especially in the direction of arabica and specialty coffees as recommended by Morjaria & Sprott (2018). Primary processing, productivity and value-chain enhancement policies should be enforced to minimise loss of quality along the way.

5.5. Areas for further research

The massive effect of the global average long-term atmospheric concentration of carbon dioxide (CO_2) in parts per million (ppm) (X_2) on U.S. coffee imports from Uganda seems curious and warrants further research especially given the longstanding debate on the effect of greenhouse gases on climate change (Eggleton, 2013). The study's findings also show that the effects of Fairtrade pricing are not obvious and could lead to worse outcomes for Uganda's coffee. This warrants further research into sustainable practices around coffee (like certification), especially now as the interest in sustainable coffee development is growing (UNCTAD, 2018). This study focussed on coffee, future studies could look at say fish, cut flowers even clothing and textiles, which are also major exports of Uganda and eligible for AGOA. In addition, the recent COVID-19 outbreak and its associated lockdowns have greatly affected international coffee trade (UCDA, 2020). Further research should explore how to make Uganda's coffee industry more resilient to such shocks.

5.6. Limitations of the study

This study was limited by a small dataset characterised by several missing observations that resulted in the small unbalanced panel used for analysis plus the low R^2 and high p-value reported in table 4.3. Missing data is common in studies on trade but with time more data becomes available so that sufficient cross-section and time series data for various product classes may be obtained. Future studies may use the similar approaches to improve the rigour of the analysis and external validity of the findings.

References

Agoa.info. (2020). Uganda - Agoa.info - African Growth and Opportunity Act. Retrieved February 22, 2020, from https://agoa.info/profiles/uganda.html

AGOA.info. (2016). Uganda calls for review of AGOA rules of origin. Retrieved November 22, 2019, from https://agoa.info/news/article/6191-uganda-calls-for-review-of-agoa-rules-of-origin.html

AGOA.info. (2019a). About AGOA - Agoa.info - African Growth and Opportunity Act. Retrieved October 27, 2019, from https://agoa.info/about-agoa.html

AGOA.info. (2019b). AGOA+GSP Trade - Agoa.info - African Growth and Opportunity Act. Retrieved November 17, 2019, from https://agoa.info/data/trade.html

AGOA.info. (2019c). AGOA Country Eligibility - Agoa.info - African Growth and Opportunity Act. Retrieved October 27, 2019, from https://agoa.info/about-agoa/country-eligibility.html

AGOA Response Office - MTIC Uganda. (2019). *AGOA 101 UGANDA*.

Alam, T. (2019). Forecasting exports and imports through artificial neural network and autoregressive integrated moving average. *Canada. Decision Science Letters*, *8*, 249–260. https://doi.org/10.5267/j.dsl.2019.2.001

Baltagi, B. H. (2005). *Econometric Analysis of Panel Data, 3rd Edition*.

Bank of Uganda. (2019). Bank of Uganda (BoU) | Statistics | Composition of Exports. Retrieved November 22, 2019, from https://www.bou.or.ug/bou/bouwebsite/Statistics/Statistics.html

Basalamah, S. (2019, January 9). Cross Validation of an Artificial Neural Network - Medium. Retrieved May 31, 2020, from https://medium.com/@salsabilabasalamah/cross-validation-of-an-artificial-neural-network-f72a879ea6d5

Baxter, G., & Srisaeng, P. (2018). The Use Of An Artificial Neural Network To Predict Australia's Export Air Cargo Demand.

Blendon, R. J., Casey, L. S., Benson, J. M., & Casey, S. (2017). Public Opinion and Trump's Jobs and Trade Policies. *Challenge*, *60*(3), 228–244. https://doi.org/10.1080/05775132.2017.1308763

Bryceson, D. F., & Jamal, V. (2019). *Farewell to farms: De-agrarianisation and Employment in Africa*. (D. F. Bryceson & V. Jamal, Eds.), *Farewell to Farms: De-Agrarianisation and Employment in Africa*. Taylor and Francis Group. https://doi.org/10.4324/9780429442674

Cooke, E. F. A. (2014). *Essays on Trade Preferences of the USA and Exports of Developing Countries*.

Croissant et al. (2020, February 28). Package ‘plm’ | Linear Models for Panel Data. Retrieved June 2, 2020, from https://cran.r-project.org/web/packages/plm/plm.pdf

Deininger, K., & Ali, D. A. (2008). Do overlapping land rights reduce agricultural investment? evidence from Uganda. *American Journal of Agricultural Economics*, *90*(4), 869–882. https://doi.org/10.1111/j.1467-8276.2008.01171.x

Didia, D., Nica, M., & Yu, G. (2015). The gravity model, African Growth and Opportunity Act (AGOA) and US trade relations with sub-Saharan Africa. *Journal of International Trade and Economic Development*, *24*(8), 1130–1151. https://doi.org/10.1080/09638199.2014.1000942

Dumor, K., & and Yao, L. (2019). Estimating China’s Trade with Its Partner Countries within the Belt and Road Initiative Using Neural Network Analysis.

Eggleton, T. (2013). *A Short Introduction to Climate Change* (1st ed., Vol. 1 of 1). Cambridge University Press. Retrieved from https://books.google.co.ke/books?id=jeSwRly2M_cC&pg=PA52&lpg=PA52&dq=280&redir_esc=y#v=onepage&q=280&f=false

Epule, T. E., Ford, J. D., Lwasa, S., Nabaasa, B., & Buyinza, A. (2018). The determinants of crop yields in Uganda: what is the role of climatic and non-climatic factors? *Agriculture & Food Security*, *7*(1), 10. https://doi.org/10.1186/s40066-018-0159-3

FAO. (2014). *Understanding smallholder farmer attitudes to commercialization – The case of maize in Kenya. Rome.* (A. Woolverton & D. Neven, Eds.). Rome. Retrieved from http://www.fao.org/3/a-i3717e.pdf; http://www.intracen.org/uploadedFiles/intracenorg/Content/Publications/More from the Cup_final_Low-res.pdf

Fernandes, A. M., Forero, A., Maemir, H., & Mattoo, A. (2019). *Are Trade Preferences a Panacea? The African Growth and Opportunity Act and African Exports*. Retrieved from http://www.worldbank.org/research.

Frazer, G., & Steenbergen, V. (2017). *Uganda: Responding to the US threat to remove AGOA preferences*. Retrieved from www.theigc.org

Frazer, G., & Van Biesebroeck, J. (2010). Trade Growth Under The African Growth And Opportunity Act.

Gebreyesus, T. (2015). Determinants of Coffee Export Performance in Ethiopia.

Hainmueller, J., Hiscox, M. J., & Sequeira, S. (2014). Consumer Demand for the Fair Trade

Label: Evidence from a Multi-Store Field Experiment. Retrieved from https://www.hbs.edu/faculty/conferences/2014-launching-the-star-lab/Documents/FT_final_2_20.pdf

Hou, J. (2018, May 20). RPubs - Simple Neural Network for Nutrition Rating Prediction. Retrieved May 31, 2020, from https://rpubs.com/JanpuHou/390906

Hussien, H. B. (2015). *Determinants of Coffee Export Supply in Ethiopia: Error Correction Modeling Approach*. *Journal of Economics and Sustainable Development www.iiste.org ISSN* (Vol. 6). Online. Retrieved from www.iiste.org

ICO. (2015). *Sustainability Of The Coffee Sector In Africa*.

IPCC. (2018). *Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. Aromar Revi*. Retrieved from https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_SPM_version_report_LR.pdf

IPCC. (2019). Chapter 5: Food Security.

ITC. (2012). *The Coffee Exporter's Guide*. *The Coffee Exporter's Guide*. https://doi.org/10.18356/a556dbd7-en

ITC. (2016). *Coffee Sector Investment Profile: Uganda*. Retrieved from http://www.intracen.org/uploadedFiles/intracenorg/Content/Redesign/Projects/SITA/SITA_Uganda_Coffee_booklet_final_web_page.pdf

ITC. (2020a). *More from the cup: Better returns for East African coffee producers. International Trade Centre, Geneva.* Geneva. Retrieved from http://www.intracen.org/uploadedFiles/intracenorg/Content/Publications/More from the Cup_final_Low-res.pdf

ITC. (2020b, May 23). 13.2.4-Climate change and the coffee industry-The coffee sector and climate change. Retrieved May 23, 2020, from http://www.intracen.org/coffee-guide/climate-change-and-the-coffee-industry/the-coffee-sector-and-climate-change/

Jassogne, L., Läderach, P., & Van Asten, P. (2013). *The Impact of Climate Change on Coffee in Uganda: Lessons from a case study in the Rwenzori Mountains*. Oxford (UK). Retrieved from https://www.oxfamblogs.org/eastafrica/wp-content/uploads/2010/09/rr-impact-climate-change-coffee-uganda-030413-en.pdf

Kassa, W., & Coulibaly, S. (2019). *Revisiting the Trade Impact of the African Growth and Opportunity Act A Synthetic Control Approach*. Retrieved from http://www.worldbank.org/prwp.

Klasen, S., Martínez-Zarzoso, I., Nowak-Lehmann, F., & Bruckner, M. (2016). *Trade Preferences for Least Developed Countries. Are they Effective? Preliminary Econometric Evidence*. Retrieved from http://ptadb.wto.org/ptaList.aspx.

Lawry et al. (2016). *The impact of land property rights interventions on investment and agricultural productivity in developing countries: a systematic review*. London. Retrieved from https://www.3ieimpact.org/sites/default/files/2019-01/sr14-qa-land-property-rights-review.pdf

Legesse, A. (2019). Climate Change Effect on Coffee Yield and Quality: A Review. *International Journal of Forestry and Horticulture (IJFH)*, *5*(4), 1–99. https://doi.org/10.20431/2454-9487.0504001

Limão, N. (2016). *Preferential Trade Agreements*. Cambridge, MA. https://doi.org/10.3386/w22138

Mordor Intelligence. (2020, May). United States Coffee Market - Growth, Trends, Forecasts (2020-2025). Retrieved May 23, 2020, from https://www.mordorintelligence.com/industry-reports/united-states-coffee-market

Morjaria, A., & Sprott, M. (2018). *Ugandan Arabica coffee value chain opportunities*. Retrieved from http://www.coffeereview.com/top-30-coffees-2017/page/2/

Mpunga, H. S. (2016). Examining the Factors Affecting Export Performance for Small and Medium Enterprises (SMEs) in Tanzania. *Journal of Economics and Sustainable Development Www.Iiste.Org ISSN*, *7*(6). Retrieved from www.iiste.org

Mulinde, C., Majaliwa, J. G. M., Twinomuhangi, R., Mfitumukiza, D., Komutunga, E., Ampaire, E., … Jassogne, L. (2019). Perceived climate risks and adaptation drivers in diverse coffee landscapes of Uganda. *NJAS - Wageningen Journal of Life Sciences*, *88*, 31–44. https://doi.org/10.1016/j.njas.2018.12.002

Mwesigwa, A. (2015). Uganda has little to show for African trade agreement after 14 years | Alon Mwesigwa | Global development | The Guardian. Retrieved November 22, 2019, from https://www.theguardian.com/global-development/2015/jan/02/uganda-african-trade-growth-and-opportunity-act-us-14-years-on

Naegele, H. (2019). *Where Does the Fairtrade Money Go? How Much Consumers Pay Extra for*

Fairtrade Coffee and How This Value Is Split along the Value Chain (DIW Discussion Papers No. 1783). Berlin. Retrieved from https://www.econstor.eu/bitstream/10419/191910/1/1048609618.pdf

Nassr, I. K., Robano, V., & Wehinger, G. (2016). *Unleashing the Export Potential of SMEs in Greece*. https://doi.org/10.1787/5jm0qgt464f6-en

Nsubuga, F. W., & Rautenbach, H. (2018). Climate change and variability: a review of what is known and ought to be known for Uganda. *International Journal of Climate Change Strategies and Management*, *10*(5), 1756–8692. https://doi.org/10.1108/IJCCSM-04-2017-0090

Nuroğlu, E. (2014). Estimating And Forecasting Trade Flows By Panel Data Analysis And Neural Networks.

Olarreaga, M., & Özden, Ç. (2005). AGOA and Apparel: Who captures the tariff rent in the presence of preferential market access? *World Economy*, *28*(1), 63–77. https://doi.org/10.1111/j.1467-9701.2005.00642.x

Pasape, L. (2018). Internationalization of Small and Medium Enterprises from Arusha Tanzania: Market Information, Financial Resources and Product Quality Setbacks. *Business and Management Studies*, *4*(2). https://doi.org/10.11114/bms.v4i2.3268

Persson, M. (2013). *Trade Preferences from a Policy Perspective* (No. 2013:3). Lund, Sweden. Retrieved from https://project.nek.lu.se/publications/workpap/papers/WP13_3.pdf

Pham et. al. (2019). The impact of climate change and variability on coffee production: a systematic review. *Climatic Change*, *156*(4), 609–630. https://doi.org/10.1007/s10584-019-02538-y

Ruben, R., & Hoebink, P. (2015). *Impact of multiple certification on smallholder coffee farmers' livelihoods: Evidence from southern Ethiopia*. (R. Ruben & P. Hoebink, Eds.). Wageningen, The Netherlands: Wageningen Academic Publishers. https://doi.org/10.3920/978-90-8686-805-6_4

Tadesse, B., & Fayissa, B. (2008). The Impact of African Growth and Opportunity Act (AGOA) on U.S. imports from Sub-Saharan Africa (SSA). *Journal of International Development*, *20*(7), 920–941. https://doi.org/10.1002/jid.1446

Torok, A., Mizik, T., & Jambor, A. (2017). Comparative advantages in the global coffee trade. *ResearchGate*. Retrieved from https://www.researchgate.net/publication/321094949_Comparative_advantages_in_the_glo bal_coffee_trade

Torres-Reyna, O. (2020, May 23). Getting Started in Fixed/Random Effects Models using R (ver. 0.1-Draft). Retrieved May 23, 2020, from https://dss.princeton.edu/training/Panel101R.pdf

U.S. Embassy in Uganda. (2019). U.S. Embassy Kampala Statement on Recent Events | April 23, 2019 | U.S. Embassy in Uganda. Retrieved November 17, 2019, from https://ug.usembassy.gov/u-s-embassy-kampala-statement-on-recent-events-april-23-2019/

UCDA. (2020). *UCDA Monthly Report - April 2020*. Kampala.

UNCTAD. (2018). *Commodities At A Glance - Special issue on coffee in East Africa*. Geneva. Retrieved from https://unctad.org/en/PublicationsLibrary/ditccom2018d1_en.pdf

USDA Foreign Agricultural Service. (2019a). *Coffee: World Markets and Trade*.

USDA Foreign Agricultural Service. (2019b). *GAIN Report on Uganda - Coffee Annual*.

USITC. (2014). *AGOA: Trade and Investment Performance Overview*.

Verter, N., Bamwesigye, D., & Darkwah, S. A. (2015). Analysis of Coffee Production and Exports in Uganda.

Voora et. al. (2019). *Global Market Report: Coffee*. Retrieved from https://www.iisd.org/sites/default/files/publications/ssi-global-market-report-coffee.pdf

Wang, B., Luo, X., Yang, Y. M., Sun, W., Cane, M. A., Cai, W., … Liu, J. (2019). Historical change of El Niño properties sheds light on future changes of extreme El Niño. *Proceedings of the National Academy of Sciences of the United States of America*, *116*(45), 22512–22517. https://doi.org/10.1073/pnas.1911130116

Wohl, I., & Kennedy, J. (2018). *Neural Network Analysis of International Trade*. Retrieved from www.usitc.gov

WTO. (2016). *World Trade Report 2016: Levelling the trading field for SMEs*. Retrieved from www.wto.org

Zenebe, A., Wamisho, K., Wesley, E., & Peterson, F. (2015). The Impact Of The African Growth And Opportunity Act (Agoa): An Empirical Analysis Of Sub-Saharan Africa Agricultural Exports To The United States.

Appendices

Appendix A: Possible determinants of U.S. coffee imports from Uganda (Proposed Independent Variables)

	Independent Variables	Definition	Description (Proxy)	Anticipated Effect on M_{ijt}	Source
1	Incumbent U.S. President (D)	Republican / Democrat	Binary, Dummy (D_1)	TBD	U.S. White House Official website
2	Election Year (U.S.)	Year of presidential election in U.S.	Binary, Dummy (D_2)	-	U.S. White House Official website
3	Election Year (UG)	Year of presidential election in Uganda	Binary, Dummy (D_3)	-	Uganda Electoral Commission
4	Population (U.S.)	Total U.S. population	Continuous (POP_{jt})	+	World Bank Database
5	Population (Uganda)	Total Uganda population	Continuous (POP_{it})	+	World Bank Database
6	U.S. GDP	GDP of the U.S.	Continuous (GDP_{jt})	+	World Bank Database
7	Uganda GDP	GDP of Uganda	Continuous (GDP_{it})	+	World Bank Database
8	Uganda's Road Coverage	Km of standard paved roads to total network	Continuous ($ROAD_{it}$)	+	UNRA, MoWT
9	Uganda's Air Traffic	Registered carrier departures – Uganda	Continuous (AIR_{it})	+	World Bank Database
10	Exchange Rate	Annual change in UGX/USD exchange rate	Continuous, Percentage (FRT_{it})	+	World Bank Database
11	U.S. Urbanisation Rate	Urban population growth (annual %) – U.S.	Continuous, Percentage (U_{jt})	+	World Bank Database
12	Uganda Urbanisation Rate	Urban population growth (annual %) - Uganda	Continuous, Percentage (U_{it})	+	World Bank Database
13	GFC recession	Years 2007 – 2010	Binary, Dummy (D_4)	-	Official U.S. FCIC Report
14	World coffee market price	Coffee C Futures Contract in $ per pound	Continuous (E_1)	+	UNCTAD, ICO Statistics
15	Coffee Fairtrade Price	Fairtrade Foundation minimum price	Continuous (E_2)	+	Fairtrade Foundation
16	Coffee Price Volatility	Standard deviation of Coffee C Futures Contract in $ per pound	Continuous (E_3)	-	UNCTAD Coffee Report 2018
17	World Commodity Supply	Quantity of commodity produced globally	Continuous (E_4)	-	UNCTAD
18	AGOA membership	Pre-AGOA year = 0, Post-AGOA year =1	Binary, Dummy (AGOA)	+	AGOA.info website
19	Exporting experience	AGOA Years elapsed since first product export	Discrete (E_5)	+	Constructed discrete variables

20	Coffee Farmers' Age	Average age of population	Continuous (S_1)	-	UBOS, World Bank Data
21	Openness to trade (Uganda)	Uganda's economic openness to trade	Continuous, Percentage (S_2)	+	World Bank WITS Database
22	Openness to trade (U.S.)	U.S.' economic openness to trade	Continuous, Percentage (S_3)	+	World Bank WITS Database
23	Farmed Area specific to coffee	Area harvested (Coffee, green)	Continuous (S_4)	+	FAO, UBOS
24	Establishment of National Agricultural Advisory Services (NAADS)	Year NAADS was in existence = 1, Else = 0	Continuous (T_2)	+	NAADS
25	Establishment of Uganda Coffee Development Authority (UCDA)	Year UCDA was in existence = 1, Else = 0	Binary, Dummy (UCDA)	+	Constructed discrete variables
26	Precipitation	Experienced El Niño = 1, Else = 0	Binary, Dummy (X_1)	-	Uganda National Meteorological Authority
27	Global CO_2 Emissions	Global average long-term atmospheric concentration of carbon dioxide (CO_2)	Continuous (X_2)	-	Our World in Data (University of Oxford)
28	Uganda's Mean Surface Temperature Change	Mean surface temperature change for Uganda	Continuous (X_3)	-	FAO
29	Global warming	Global average land-sea temperature anomaly relative to the 1961-1990 average temperature in degrees Celsius (°C).	Continuous (G)	-	Our World in Data (University of Oxford)
30	National Export Policy (2008)	Years since National policy was passed	Discrete (L_1)	+	Constructed Discrete Variable

Appendix B: Data used to address objective 1 and 2 (n = 7, T = 1-24, N = 76)

	Product	Year	Ln Mijt	D2	D3	fdLn POPit	fdLn GDPit	fdLn ROADit	fdLn AIRit	fdUjt	D4	fdLn E2	Ln E3	AGOA	S2	fdS3	fdLn S4	X1	fdLn X2	Ln X3
1	90111	1995	8.143	0	0	0.0308	0.3663	0.0207	-0.5108	-0.0445	0	0.0509	-1.4491	0	26.3386	1.2515	0	0	0.0055	-0.6675
2	90111	1996	8.8892	1	1	0.0299	0.049	0.0325	0	-0.0337	0	0	-2.549	0	29.4148	0.1809	0.0626	0	0.0049	-0.9416
3	90111	1997	9.5263	0	0	0.0292	0.0365	0.0306	0	0.0292	0	0	-1.1263	0	29.8437	0.5909	-0.029	1	0.0031	-0.3754
4	90111	1998	8.5017	0	0	0.0289	0.0491	0.0352	0	-0.0443	0	0	-1.4894	0	29.1124	-0.5689	-0.0261	1	0.0081	-0.8463
5	90111	1999	9.3542	0	0	0.0292	-0.0932	0.047	1.204	-0.0247	0	0	-2.0808	0	31.0241	0.2786	0.037	0	0.0046	-1.8905
6	90111	2000	8.8529	1	0	0.0299	0.0319	0.0317	-2.4342	-0.1009	0	0	-1.933	1	31.3083	1.6843	0.0903	0	0.0032	-0.7215
7	90111	2001	8.5179	0	1	0.0308	-0.0586	0.0296	0.0113	-0.2986	0	0	-2.5622	1	35.0141	-1.8762	-0.1311	0	0.0043	-1.3243
8	90111	2002	8.1261	0	0	0.0314	0.0563	0.0217	-0.0113	-0.065	0	0	-2.6384	1	24.6012	-0.7214	-0.1937	0	0.0057	-0.2666
9	90111	2003	8.7158	0	0	0.0318	0.0253	0.0154	0	-0.0701	0	0	-3.4798	1	30.0945	0.3853	0.1937	0	0.0067	-0.1358
10	90111	2004	8.3186	1	0	0.0318	0.2256	0.0033	0.1383	0.0655	0	0	-2.3991	1	29.9734	1.4658	0	0	0.0046	-0.3161
11	90111	2005	8.9402	0	0	0.0317	0.1268	0.0108	0.0485	-0.008	0	0	-2.1355	1	31.8067	1.0397	-0.0038	0	0.006	0.3464
12	90111	2006	8.3648	0	1	0.0315	0.0981	0.0199	0.0402	0.0421	0	0	-2.448	1	35.3932	1.1081	-0.1785	0	0.0055	0.0751
13	90111	2007	8.3601	0	0	0.0315	0.2122	0.0039	0.0674	-0.0149	1	0	-2.4897	1	39.2912	0.6141	0.2589	0	0.0049	-0.7113
14	90111	2008	8.319	1	0	0.0316	0.147	0.0096	-0.0114	-0.0069	1	0.0325	-1.961	1	43.8934	1.5708	0.1911	0	0.0047	-0.3916
15	90111	2009	8.9353	0	0	0.0317	0.2437	0.0538	0.0283	-0.0709	1	0	-2.2155	1	32.0052	-5.0771	-0.0752	0	0.0047	0.2021
16	90111	2010	9.2423	0	0	0.0319	0.1053	0.0531	2.8634	-0.0503	1	0	-1.1796	1	31.1248	3.2437	-0.1603	0	0.0064	0.2523
17	90111	2011	8.8836	0	1	0.0318	-0.0005	0.0198	-0.254	-0.0963	0	0.1133	-1.5563	1	38.6102	2.4552	0.1512	0	0.0045	-0.1637
18	90111	2012	8.8629	1	0	0.0318	0.136	0.0161	0.2052	0.0108	0	0	-1.5065	1	36.3455	-0.149	-0.0005	0	0.0056	0.0639
19	90111	2013	9.302	0	0	0.0323	0.0623	0.0507	0.3635	-0.0347	0	0	-1.9764	1	33.4396	-0.682	0.2004	0	0.0068	0.0478
20	90111	2014	8.8398	0	0	0.0335	0.1039	0.0839	-0.2273	0.0453	0	0	-1.4181	1	30.5439	-0.2692	-0.0002	0	0.0054	0.0908
21	90111	2015	8.9892	0	0	0.035	-0.007	0.0478	-1.0796	0.0076	0	0	-1.8893	1	28.761	-2.0625	0.1095	1	0.0055	0.1458
22	90111	2016	9.0964	1	1	0.0365	-0.116	0.0433	0.4956	-0.0108	0	0	-1.8948	1	30.2938	-1.1704	-0.1047	1	0.0085	0.2319
23	90111	2017	9.239	0	0	0.0375	0.0743	0.0238	-0.673	-0.0774	0	0	-2.4524	1	32.687	0.5112	-0.0259	0	0.0057	0.4929
24	90111	2018	9.4027	0	0	0.0372	0.0549	0.0668	0.9059	-0.0192	0	0	-2.5184	1	35.1839	0.5293	0.0399	1	0.0048	-0.0356
25	90112	1995	5.4821	0	0	0.0308	0.3663	0.0207	-0.5108	-0.0445	0	0.0509	-1.4491	0	26.3386	1.2515	0	0	0.0055	-0.6675
26	90112	1996	5.5674	1	1	0.0299	0.049	0.0325	0	-0.0337	0	0	-2.549	0	29.4148	0.1809	0.0626	0	0.0049	-0.9416
27	90112	1997	6.4783	0	0	0.0292	0.0365	0.0306	0	0.0292	0	0	-1.1263	0	29.8437	0.5909	-0.029	1	0.0031	-0.3754
28	90112	1998	5.298	0	0	0.0289	0.0491	0.0352	0	-0.0443	0	0	-1.4894	0	29.1124	-0.5689	-0.0261	1	0.0081	-0.8463
29	90112	1999	5.522	0	0	0.0292	-0.0932	0.047	1.204	-0.0247	0	0	-2.0808	0	31.0241	0.2786	0.037	0	0.0046	-1.8905
30	90112	2000	5.6049	1	0	0.0299	0.0319	0.0317	-2.4342	-0.1009	0	0	-1.933	1	31.3083	1.6843	0.0903	0	0.0032	-0.7215
31	90112	2001	2.905	0	1	0.0308	-0.0586	0.0296	0.0113	-0.2986	0	0	-2.5622	1	35.0141	-1.8762	-0.1311	0	0.0043	-1.3243
32	90112	2002	3.7252	0	0	0.0314	0.0563	0.0217	-0.0113	-0.065	0	0	-2.6384	1	24.6012	-0.7214	-0.1937	0	0.0057	-0.2666
33	90112	2003	3.8077	0	0	0.0318	0.0253	0.0154	0	-0.0701	0	0	-3.4798	1	30.0945	0.3853	0.1937	0	0.0067	-0.1358
34	90112	2004	3.7388	1	0	0.0318	0.2256	0.0033	0.1383	0.0655	0	0	-2.3991	1	29.9734	1.4658	0	0	0.0046	-0.3161
35	90112	2005	4.0174	0	0	0.0317	0.1268	0.0108	0.0485	-0.008	0	0	-2.1355	1	31.8067	1.0397	-0.0038	0	0.006	0.3464
36	90112	2006	3.9163	0	1	0.0315	0.0981	0.0199	0.0402	0.0421	0	0	-2.448	1	35.3932	1.1081	-0.1785	0	0.0055	0.0751
37	90112	2007	4.7823	0	0	0.0315	0.2122	0.0039	0.0674	-0.0149	1	0	-2.4897	1	39.2912	0.6141	0.2589	0	0.0049	-0.7113
38	90112	2008	5.2986	1	0	0.0316	0.147	0.0096	-0.0114	-0.0069	1	0.0325	-1.961	1	43.8934	1.5708	0.1911	0	0.0047	-0.3916
39	90112	2009	4.1127	0	0	0.0317	0.2437	0.0538	0.0283	-0.0709	1	0	-2.2155	1	32.0052	-5.0771	-0.0752	0	0.0047	0.2021
40	90112	2010	7.0543	0	0	0.0319	0.1053	0.0531	2.8634	-0.0503	1	0	-1.1796	1	31.1248	3.2437	-0.1603	0	0.0064	0.2523
41	90112	2011	7.0397	0	1	0.0318	-0.0005	0.0198	-0.254	-0.0963	0	0.1133	-1.5563	1	38.6102	2.4552	0.1512	0	0.0045	-0.1637
42	90112	2012	6.7388	1	0	0.0318	0.136	0.0161	0.2052	0.0108	0	0	-1.5065	1	36.3455	-0.149	-0.0005	0	0.0056	0.0639
43	90112	2013	7.9754	0	0	0.0323	0.0623	0.0507	0.3635	-0.0347	0	0	-1.9764	1	33.4396	-0.682	0.2004	0	0.0068	0.0478
44	90112	2014	7.3517	0	0	0.0335	0.1039	0.0839	-0.2273	0.0453	0	0	-1.4181	1	30.5439	-0.2692	-0.0002	0	0.0054	0.0908
45	90112	2015	2.9977	0	0	0.035	-0.007	0.0478	-1.0796	0.0076	0	0	-1.8893	1	28.761	-2.0625	0.1095	1	0.0055	0.1458
46	90112	2016	3.4277	1	1	0.0365	-0.116	0.0433	0.4956	-0.0108	0	0	-1.8948	1	30.2938	-1.1704	-0.1047	1	0.0085	0.2319
47	90112	2017	7.4869	0	0	0.0375	0.0743	0.0238	-0.673	-0.0774	0	0	-2.4524	1	32.687	0.5112	-0.0259	0	0.0057	0.4929
48	90112	2018	7.9596	0	0	0.0372	0.0549	0.0668	0.9059	-0.0192	0	0	-2.5184	1	35.1839	0.5293	0.0399	1	0.0048	-0.0356
49	90121	1997	4.318	0	0	0.0292	0.0365	0.0306	0	0.0292	0	0	-1.1263	0	29.8437	0.5909	-0.029	1	0.0031	-0.3754
50	90121	2001	-0.2206	0	1	0.0308	-0.0586	0.0296	0.0113	-0.2986	0	0	-2.5622	1	35.0141	-1.8762	-0.1311	0	0.0043	-1.3243
51	90121	2002	1.311	0	0	0.0314	0.0563	0.0217	-0.0113	-0.065	0	0	-2.6384	1	24.6012	-0.7214	-0.1937	0	0.0057	-0.2666
52	90121	2003	0.7491	0	0	0.0318	0.0253	0.0154	0	-0.0701	0	0	-3.4798	1	30.0945	0.3853	0.1937	0	0.0067	-0.1358
53	90121	2005	2.5635	0	0	0.0317	0.1268	0.0108	0.0485	-0.008	0	0	-2.1355	1	31.8067	1.0397	-0.0038	0	0.006	0.3464
54	90121	2008	-2.273	1	0	0.0316	0.147	0.0096	-0.0114	-0.0069	1	0.0325	-1.961	1	43.8934	1.5708	0.1911	0	0.0047	-0.3916
55	90121	2009	-1.6296	0	0	0.0317	0.2437	0.0538	0.0283	-0.0709	1	0	-2.2155	1	32.0052	-5.0771	-0.0752	0	0.0047	0.2021
56	90121	2010	-0.6951	0	0	0.0319	0.1053	0.0531	2.8634	-0.0503	1	0	-1.1796	1	31.1248	3.2437	-0.1603	0	0.0064	0.2523
57	90121	2011	2.325	0	1	0.0318	-0.0005	0.0198	-0.254	-0.0963	0	0.1133	-1.5563	1	38.6102	2.4552	0.1512	0	0.0045	-0.1637
58	90121	2012	-0.3453	1	0	0.0318	0.136	0.0161	0.2052	0.0108	0	0	-1.5065	1	36.3455	-0.149	-0.0005	0	0.0056	0.0639
59	90121	2013	0.6313	0	0	0.0323	0.0623	0.0507	0.3635	-0.0347	0	0	-1.9764	1	33.4396	-0.682	0.2004	0	0.0068	0.0478
60	90121	2018	2.9133	0	0	0.0372	0.0549	0.0668	0.9059	-0.0192	0	0	-2.5184	1	35.1839	0.5293	0.0399	1	0.0048	-0.0356
61	90122	2009	2.9977	0	0	0.0317	0.2437	0.0538	0.0283	-0.0709	1	0	-2.2155	1	32.0052	-5.0771	-0.0752	0	0.0047	0.2021
62	90122	2010	6.3616	0	0	0.0319	0.1053	0.0531	2.8634	-0.0503	1	0	-1.1796	1	31.1248	3.2437	-0.1603	0	0.0064	0.2523
63	90122	2011	5.1103	0	1	0.0318	-0.0005	0.0198	-0.254	-0.0963	0	0.1133	-1.5563	1	38.6102	2.4552	0.1512	0	0.0045	-0.1637
64	90190	2002	-1.204	0	0	0.0314	0.0563	0.0217	-0.0113	-0.065	0	0	-2.6384	1	24.6012	-0.7214	-0.1937	0	0.0057	-0.2666
65	90190	2006	3.0072	0	1	0.0315	0.0981	0.0199	0.0402	0.0421	0	0	-2.448	1	35.3932	1.1081	-0.1785	0	0.0055	0.0751
66	90190	2007	-1.9105	0	0	0.0315	0.2122	0.0039	0.0674	-0.0149	1	0	-2.4897	1	39.2912	0.6141	0.2589	0	0.0049	-0.7113
67	90190	2008	2.9987	1	0	0.0316	0.147	0.0096	-0.0114	-0.0069	1	0.0325	-1.961	1	43.8934	1.5708	0.1911	0	0.0047	-0.3916
68	90190	2009	4.8919	0	0	0.0317	0.2437	0.0538	0.0283	-0.0709	1	0	-2.2155	1	32.0052	-5.0771	-0.0752	0	0.0047	0.2021
69	90190	2010	5.5401	0	0	0.0319	0.1053	0.0531	2.8634	-0.0503	1	0	-1.1796	1	31.1248	3.2437	-0.1603	0	0.0064	0.2523
70	90190	2011	-1.5995	0	1	0.0318	-0.0005	0.0198	-0.254	-0.0963	0	0.1133	-1.5563	1	38.6102	2.4552	0.1512	0	0.0045	-0.1637
71	90190	2013	-0.3857	0	0	0.0323	0.0623	0.0507	0.3635	-0.0347	0	0	-1.9764	1	33.4396	-0.682	0.2004	0	0.0068	0.0478
72	90190	2014	0.9083	0	0	0.0335	0.1039	0.0839	-0.2273	0.0453	0	0	-1.4181	1	30.5439	-0.2692	-0.0002	0	0.0054	0.0908
73	90190	2015	-0.7277	0	0	0.035	-0.007	0.0478	-1.0796	0.0076	0	0	-1.8893	1	28.761	-2.0625	0.1095	1	0.0055	0.1458
74	210111	2011	-0.5763	0	1	0.0318	-0.0005	0.0198	-0.254	-0.0963	0	0.1133	-1.5563	1	38.6102	2.4552	0.1512	0	0.0045	-0.1637
75	210112	1997	0.4055	0	0	0.0292	0.0365	0.0306	0	0.0292	0	0	-1.1263	0	29.8437	0.5909	-0.029	1	0.0031	-0.3754
76	210112	2018	-0.3813	0	0	0.0372	0.0549	0.0668	0.9059	-0.0192	0	0	-2.5184	1	35.1839	0.5293	0.0399	1	0.0048	-0.0356

Appendix C: Data used to address objective 3 (N = 25)

	Year	Mijt	D1	D2	D3	POPjt	POPit	GDPjt	GDPit	ROADi	AIRit	FRTit	Uit	Ujt	D4	E1	E2	E3	E4	AGOA	E5	S1	S2	S3	S4	T2	UCDA	X1	X2	G	X3	L1
1	1994	11441	1	0	0	263.1	19.79	7287	3.99	2105	1500	979.4	6.03	1.731	0	1.448	1.15	0.556	91.77	0	0	48.63	32.18	16.49	263	0	3	0	358.8	0.208	0.338	0
2	1995	3680	1	0	0	266.3	20.41	7640	5.756	2149	900	968.9	5.933	1.686	0	1.463	1.21	0.235	93.31	0	0	48.57	26.34	17.74	263	0	4	0	360.8	0.325	0.513	0
3	1996	7515	1	1	1	269.4	21.03	8073	6.045	2220	900	1046	5.83	1.653	0	1.155	1.21	0.078	87.32	0	0	48.34	29.41	17.92	280	0	5	0	362.6	0.183	0.39	0
4	1997	14443	1	0	0	272.7	21.66	8578	6.269	2289	900	1083	5.737	1.682	0	1.793	1.21	0.324	103.3	0	0	48.18	29.84	18.52	272	0	6	1	363.7	0.39	0.687	0
5	1998	5123	1	0	0	275.9	22.29	9063	6.585	2371	900	1240	5.706	1.638	0	1.293	1.21	0.226	99.86	0	0	48.08	29.11	17.95	265	0	7	1	366.7	0.539	0.429	0
6	1999	11797	1	0	0	279	22.95	9631	5.999	2485	3000	1455	5.725	1.613	0	1.042	1.21	0.125	109.1	0	0	48.04	31.02	18.23	275	0	8	0	368.4	0.306	0.151	0
7	2000	7267	0	1	0	282.2	23.65	10252	6.193	2565	263	1644	5.786	1.512	0	0.905	1.21	0.145	131.5	1	0	48.05	31.31	19.91	301	0	9	0	369.6	0.294	0.486	0
8	2001	5023	0	0	1	285	24.39	10582	5.841	2642	266	1756	5.844	1.213	0	0.557	1.21	0.077	114	1	1	48.03	35.01	18.03	264	0	10	0	371.1	0.441	0.266	0
9	2002	3427	0	0	0	287.6	25.17	10936	6.179	2700	263	1798	5.899	1.148	0	0.54	1.21	0.071	108.1	1	2	48.05	24.6	17.31	217.5	1	11	0	373.3	0.496	0.766	0
10	2003	6146	0	0	0	290.1	25.98	11458	6.337	2742	263	1964	5.926	1.078	0	0.625	1.21	0.031	123.7	1	3	48.12	30.09	17.7	264	2	12	0	375.8	0.505	0.873	0
11	2004	4142	0	1	0	292.8	26.82	12214	7.94	2751	302	1810	5.924	1.144	0	0.767	1.21	0.091	106.9	1	4	48.22	29.97	19.16	264	3	13	0	377.5	0.447	0.729	0
12	2005	7702	0	0	0	295.5	27.68	13037	9.014	2781	317	1781	5.875	1.136	0	1.081	1.21	0.118	117.2	1	5	48.36	31.81	20.2	263	4	14	0	379.8	0.545	1.414	0
13	2006	4364	0	0	1	298.4	28.57	13815	9.943	2837	330	1831	5.858	1.178	0	1.085	1.21	0.086	111.8	1	6	48.43	35.39	21.31	220	5	15	0	381.9	0.506	1.078	0
14	2007	4392	0	0	0	301.2	29.49	14452	12.29	2848	353	1723	5.836	1.163	1	1.18	1.21	0.083	136	1	7	48.55	39.29	21.93	285	6	16	0	383.8	0.491	0.491	0
15	2008	4321	1	1	0	304.1	30.43	14713	14.24	2876	349	1720	5.829	1.156	1	1.326	1.25	0.141	122.5	1	8	48.69	43.89	23.5	345	7	17	0	385.6	0.395	0.676	0
16	2009	7810	1	0	0	306.8	31.41	14449	18.17	3035	359	2030	5.819	1.085	1	1.258	1.25	0.109	135.4	1	9	48.85	32.01	18.42	320	8	18	0	387.4	0.506	1.224	1
17	2010	12317	1	0	0	309.3	32.43	14992	20.19	3200	6290	2178	5.827	1.035	1	1.642	1.25	0.307	128.6	1	10	49.04	31.12	21.66	272.6	9	19	0	389.9	0.56	1.287	2
18	2011	8530	1	0	1	311.6	33.48	15543	20.18	3264	4879	2523	5.805	0.939	0	2.534	1.4	0.211	142.5	1	11	49.19	38.61	24.12	317.1	10	20	0	391.7	0.425	0.849	3
19	2012	7910	1	1	0	313.9	34.56	16197	23.11	3317	5990	2505	5.791	0.95	0	1.753	1.4	0.222	143	1	12	49.39	36.35	23.97	316.9	11	21	0	393.9	0.47	1.066	4
20	2013	13871	1	0	0	316.1	35.7	16785	24.6	3490	8616	2587	5.815	0.915	0	1.263	1.4	0.139	152.5	1	13	49.61	33.44	23.29	387.3	12	22	0	396.5	0.514	1.049	5
21	2014	8465	1	0	0	318.4	36.91	17522	27.29	3795	6864	2600	5.924	0.96	0	1.784	1.4	0.242	154.1	1	14	49.86	30.54	23.02	387.2	13	23	0	398.7	0.579	1.095	6
22	2015	8036	1	0	0	320.7	38.23	18219	27.1	3981	2332	3241	6.049	0.968	0	1.332	1.4	0.151	149.8	1	15	50.13	28.76	20.96	432	14	24	1	400.8	0.763	1.157	7
23	2016	8954	0	1	1	323.1	39.65	18707	24.13	4157	3828	3420	6.177	0.957	0	1.368	1.4	0.15	154	1	16	50.42	30.29	19.78	389.1	15	25	1	404.2	0.797	1.261	8
24	2017	12075	0	0	0	325.1	41.16	19485	26	4257	1953	3611	6.247	0.88	0	1.335	1.4	0.086	159.9	1	17	50.76	32.69	20.3	379.1	16	26	0	406.6	0.677	1.637	9
25	2018	15003	0	0	0	327.2	42.72	20544	27.46	4551	4832	3727	6.183	0.86	0	1.136	1.4	0.081	158.1	1	18	51.13	35.18	20.83	394.5	17	27	1	408.5	0.595	0.965	10

Appendix D: Ethical Approval

Strathmore UNIVERSITY

14th April 2020

Mr Olila, Gabriel
gabriel.olila@strathmore.edu

Dear Mr Olila,

RE: The Determinants of U.S. Coffee Import Volumes from Uganda Under the African Growth and Opportunity ACT, 2000 (AGOA)

This is to inform you that SU-IERC has reviewed and **approved** your above research proposal. Your application approval number is **SU-IERC0749/20.** The approval period is **14th April 2020 to 13th April 2021.**

This approval is subject to compliance with the following requirements:

i. Only approved documents including (informed consents, study instruments, MTA) will be used
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by SU-IERC.
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to SU-IERC within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to SU-IERC within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to SU-IERC.

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely,

for: Dr Virginia Gichuru,
Secretary; SU-IERC

STRATHMORE UNIVERSITY INSTITUTIONAL ETHICS REVIEW COMMITTEE (SU-IERC)
14 APR 2020
TEL: +254 (0)703 034 000
P. O. Box 59857 - 00200
NAIROBI - KENYA

Cc: Prof Fred Were,
Chairperson; SU-IERC

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Appendix E: NACOSTI Research Permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **399957**

Date of Issue: **28/April/2020**

RESEARCH LICENSE

This is to Certify that Mr.. Gabriel Olila of Strathmore University, has been licensed to conduct research in Nairobi on the topic: The Determinants Of U.S. Coffee Import Volumes From Uganda Under The African Growth And Opportunity Act, 2000 (AGOA) for the period ending : 28/April/2021.

License No: **NACOSTI/P/20/4821**

399957

Applicant Identification Number

Director General

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

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