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Acronyms and Abbreviations

2S-GMM	Two-step Generalized Method of Moments
ADF	Augmented Dickey Fuller
AfCFTA	Africa Continental Free Trade Area
AfDB	African Development Bank
AFIDEP	African Institute for Development Policy
ARDL	Auto-Regressive Distributed Lag
ASYCUDA	Automated System for Customs Data
AU	African Union
AUC	African Union Commission
CEPII	Centre d'Etudes Prospectives et d'Informations Internationales
COMESA	Common Market for Eastern and Southern Africa
COMSTAT	COMESA Statistics
DD	Demographic Dividend
DFTA	Digital Free Trade Area
DRC	Democratic Republic of Congo
EAC	East Africa Community
ECA	Economic Commission for Africa
EDI	Electronic Data Interchange
ESW	Electronic single window
EU	European Union
FDI	Foreign Direct Investment
FE	Fixed Effect
GATT	General Agreement on Tariffs and Trade
G_CRP	Government Control of Corruption

GDP	Gross Domestic Product
G_EFF	Government effectiveness
GMM	Generalized Method of Moment
GWh	Giga Watt Hour
ICT	Information and Communication Technologies
IIFs	Innovation Incubation Facilities
IMF	International Monetary Fund
IPL	Intellectual Property Licensing
IPS	Im-Pesaran-Shin
ITU	International Telecommunication Union
IV	Instrumental Variable
LEAP	Long-Range Energy Alternatives Planning System
LLC	Levin, Lins & Chu
LM	Lagrange Multiplier
LPG	Liquid Petroleum Gas
LSDVC	Least square dummy variable bias corrected
MG	Mean Group
NTM	Non-Tariff Measures
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
ONA	One Network Area
PJ	Petajoules
PMG	Pooled Mean Group
PMGE	Pooled Mean Group Estimation
PPML	Poisson pseudo-maximum-likelihood estimator
PRIs	Public Research Institutions
R&D	Research and Development
RE	Radom Effect Abbreviations/Acronyms
RICV	Realized Imputed Commercial Value
ROL	Rule of Law
SADC	Southern African Development Community
SSA	Sub-Saharan Africa
TFP	Total Factor Productivity
TVETs	Technical Vocational Education and Training Institutions
TTOs	Technology Transfer Offices
UNCTAD	United Nations Conference on Trade and Developement
UN	United Nations
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNFPA	United Nations Population Fund
US	United States
VIF	Vector Inf
WGI	World Governance Indicators
WTO	World Trade Organisation
WCO	World Customs Organisation
WDI	World Development Indicators

PREFACE

Key Issues in Regional Integration is an annual publication of COMESA Secretariat. This edition is motivated by the critical role the academia-industry linkage can play in exploiting the opportunities created by the demographic dividend through appropriate smart social and economic investment and policies. The UN estimates that Africa will make up a quarter of the world population by 2050 with an average 60% of the population being under 24 years. This youth bulge presents a great opportunity for social economic transformation of the Common Market for Eastern and Southern Africa (COMESA) region through tapping into the vigour and idealism of youth and commercialising ideas into industries in the context of innovation and the fourth industrial revolution. The edition therefore provides a platform for disseminating research output on regional integration not only from COMESA secretariat, but also from these key constituencies.

This volume consists largely of empirical and a few theoretical research papers under the overall theme "Harnessing the Demographic Dividend for Social Economic Transformation and Deep Regional Integration in COMESA through Academia-Industry Linkages". The papers address themselves to a wide range of topical themes namely: Harnessing the Demographic Dividend through Commercialization of Local Research in COMESA; Impact of Implementing Digital Trade Facilitation on Intra-COMESA Exports; The Role of Fiscal Policy in Harnessing Demographic Dividend for Social-Economic Transformation in the Common Market for Eastern and Southern Africa; Effect of Demographic Transition on Manufacturing Sector in COMESA; The Impact of the Demographic Structure on Energy Demand in COMESA; and Assessment of the Entrepreneurial Intent for Technology Businesses by Technical and Vocational Education and Training (TVET)

Students in Kenya

The purpose of this edition is to educate the reader on the various linkages between academia and industry and how through regional integration the demographic dividends can be harnessed. It stretches the scope of readership to cover researchers on international trade, innovation and regional integration and avails to the reader insightful dimension of issues at the frontier of integration debate in the COMESA region and African continent at large.

The journey of writing this edition commenced with presentation of research papers at the fifth COMESA-Annual Research Forum held in Nairobi, Kenya in August 2018. Following a rigorous peer review process, select papers were presented at the plenary session of the Forum where they were discussed and subjected to further sit-in review and comments by participants. In the final round, a small band of papers were selected for publication on the basis of their relevance, conceptual and methodological robustness. This whole process was however, fraught with some problems. Some good papers were dropped for lack of relevant and up to date data and for inability of authors to complete revisions within scheduled timelines.

Majority of the empirical papers relied on secondary sources of data. A few, however, collected primary data through field surveys in different countries. The novelty in this edition however, is found in the empirical basis of analysis deployed and the participation of academia and industry at the Research Forum and peer review process.

Several institutions and people were instrumental in the process leading up to this publication and their involvement is gratefully acknowledged. The COMESA Secretariat under the leadership of the Secretary General Ms Chileshe Mpundu Kapwepwe, and the Division of Trade and Customs under the stewardship of Dr Francis Mangeni deserve special mention. The support of the Editorial Team (Benedict Musengele, Tasara Muzorori, Jane Kibiru and Mwangi Gakunga) is highly appreciated.

Impact Of Implementing Digital Trade Facilitation on Intra-Comesa Exports

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Abstract

This study investigated the impact of implementing digital trade facilitation reforms on intra-COMESA exports. The gravity model of trade analysis and counterfactual simulations methodologies were employed. The study confirmed that scaling up implementation of digital trade facilitation would stimulate intra-COMESA exports. A 1% increase in implementation score would result in 0.55% increase in intra-COMESA exports. This effect is equivalent to average tariff reduction by 10.4%. Simulations have shown that if all COMESA Member States scale up implementation of digital trade facilitation to at least 50%, the region would realise annual intra-exports gains of approximately US$5.9 billion. On a more ambitious scenario of full implementation of digital trade facilitation by all Member States, the region would gain annual intra-exports of US$12.3 billion. Countries with lower implementation levels present greater potential for the region. Therefore the study recommends that Member States with low implementation score should focus on policies that speed up implementation of digital trade facilitation reforms in order to stimulate intra-regional trade. There is greater variability in current implementation levels from one country to another, thus the region should consider country specific circumstance when developing policies to support implementation of digital trade facilitation in the form of Electronic Data Interchange (EDI) systems and electronic single window systems.

1.0 Introduction

The contemporary production networks relying on just-in-time delivery system and the integration of value chains across borders demand that trade becomes faster, predictable and more coordinated than ever before (World Bank, 2017). The current wave of digitalisation of the global economy presents great opportunities to enable countries to trade more, better and reliably through implementing digital trade facilitation reforms. Digital trade facilitation is defined as the modern application of information and communication technologies (ICTs) to simplify and automate procedures involved in moving goods across borders, (Duval, Utoktham, & Kravchenko, 2018 and Duval & Mengjing, 2017). ICTs application to trade procedures range from simple email based systems, through web based electronic data interchange (EDI) system to the most sophisticated electronic single window systems.

Duval & Kravchenko, (2017) listed digital trade facilitation measures into two classes as summarised in table 1.

Table 1: Digital Trade Facilitation Measures

#	Paperless trade facilitation measures	#	Cross border trade facilitation measures
1	Electronic automated customs system	1	Laws and regulations for electronic transaction in place
2	Electronic single window	2	Existence of a recognised certification authority issuing digital certificates to traders to conduct electronic transactions
3	Electronic submission of trade related documents	3	Engagement of a country in trade related cross border electronic data exchange with other countries

4	Electronic application and issuance of trade licenses and certificates of origin	4	Electronically exchanging certificates of origin and Sanitary and Phyto-sanitary between your country and other countries
5	Availability of internet connection to agencies at the borders	5	Banks and insurance companies in your country retrieving letters of credit electronically without lodging paper documents
6	E-payment of customs duties and fees		
7	Electronic application of customs refund		

Author's summary from Duval & Kravchenko, (2017)

Whilst paperless trade facilitation measures enables efficient coodination and exchange of data and documents among government border agencies and business community within a country, the cross border trade facilitation measures forms the basic building blocks for exchanging and mutual recognition of electronic trade data and documents along the entire international supply chain, (Duval & Mengjing, 2017).

There exist mutual consensus in literature that the greatest proportion of trade costs is attributable to non-tariff barriers. Hence, implementing the measures listed in Table 1 will provide a greater opportunity to lower these costs, (Duval & Kravchenko, 2017; Duval, Utoktham, & Kravchenko, 2018 and Duval & Mengjing, 2017). According to the Iceberg Theory of trade costs and the Comparative Advantage Theory of trade, reducing trade costs will stimulate exports. However, evidence to support the claim that implementing digital trade facilitation increases exports is scarce. It is therefore important for policy makers to understand the magnitude of expected economic gains from committing resources to implement digital trade facilitation.

1.1 Problem Statement

Provisions for the implementation of digital trade facilitation reforms in the World Trade Organisation (WTO) Trade Facilitation Agreement and Africa Continental Free Trade Area (AfCFTA) Annex 4 on trade facilitation are best endeavours. Given that the provisions are not mandatory, their implementation may not be prioritised. Therefore, to get the implementation of digital trade facilitation prioritised, there is need to generate empirical evidence demonstrating the gains from undertaking such reforms. Literature on digital trade facilitation is still emerging and its impact on trade costs and consequently on bilateral trade flows is based on case studies and ad hoc evidence. Thus, there is need to generate evidence using COMESA Member States data in order to provide a case for implementation of digital trade facilitation reforms.

1.2 Objectives of the Study

This study provides a regional view of the possible implication of enhancing implementation of digital trade facilitation on intra-COMESA exports performance. Hence, the study sought to:

i. Assess the impact of the current level of implementation of digital trade facilitation on intra-COMESA exports; and
ii. Estimate the regional gain in intra-COMESA exports when all Member States fully implement digital trade facilitation.

2.0 Review of the Literature

2.1 Transaction Costs Theory

International trade costs can be viewed in an iceberg model as a fraction of the traded goods themselves, (Hewitt & Gillson, 2003). The iceberg model postulates that only a fraction of ice exported reaches its destination as un-melted ice, (Samuelson, 1954). In order for one unit of shipped good to reach its destination, γ >1 units of the good must be shipped (Ferguson & Forslid, 2011). That is, a portion of the traded goods is used to pay for services to move goods from the factory-gate to the final consumer. Thus, reducing these trade transaction costs would result in more goods reaching their destination. Alternatively, bilateral trade transaction costs can be expressed as the difference between the factory-gate price in the origin country and the delivered price in the importing country as follows:

$$t_{ij} = p_{ij} - p_i \quad \text{..... (1)}$$

Where t_{ij} is the transaction costs between country i and j, p_{ij} is the delivered price in the destination country j, and p_i is the factory-gate price in the country of origin i.

Moving goods from the factory-gate in the origin country to the final consumers in the importing country involves other intermediaries that provide various services in support of the exchange. These intermediaries are rewarded by charging a fee for the services (transaction costs).

Making delivered price the subject of formula, we have:

$$p_{ij} = p_i + t_j \quad \text{..... (2)}$$

Equation (2) shows that the delivered prices in the destination country are explained by the factory-gate prices in the country of origin which is marked up by bilateral transaction costs, (Yotov et al., 2017). According to the law of demand, highly priced goods are less demanded and the vice versa. Therefore, it can be inferred from equation (2) that the ideal conditions that favour exports from country i to country j are efficient production yielding low factory-gate price and low transaction costs between the two countries.

Following Yotov et al., (2017), the supply side perspective of the delivered price can be expressed as a function of production costs and transaction costs as follows:

$$p_{ij} = \left(\frac{\delta_i}{\eta_i(l)} \right) t_{ij} \quad \text{..... (3)}$$

Where p_{ij} is the delivered price in the destination country *j*, $\left(\frac{\delta_i}{\eta_i(l)} \right)$ is the cost of producing a unit of good *l* in country *i*, δ_i denotes input costs in country *i*, $\eta_i(l)$ is the efficiency in producing good *l* in country *i* and t_{ij} is the trade transaction costs between country *i* and *j*.

Equation (3) states that the price of exports in the destination country is a function of input costs in the country of origin, production efficiency in the country of origin and transaction costs between the two countries. Lower unit input costs, high production efficiency and low

transaction costs are expected to make exports from country i more competitive in country j's market. Thus, export volumes are expected to increase in accordance with the theory of demand, (Yotov et al., 2017).

2.2 Digital Trade Facilitation and the Comparative Advantage Theory of Trade

The Comparative Advantage Theory of Trade postulates that international trade takes place between two countries with different comparative advantages and it assumes a two country, i and j case, each producing two products x and y and each country has a fixed means of production which is immobile between countries.

From equation (3), production costs of x and y in country *i* are $\frac{\delta_i}{\eta_{i(x)}}$ and $\frac{\delta_i}{\eta_{i(y)}}$; the production costs of x and y in country *j* are $\frac{\delta_j}{\eta_{j(x)}}$ and $\frac{\delta_j}{\eta_{j(y)}}$. County *i* export x to *j* and import y from *j* whilst country *j* export y to *i* and import x from *i*. In order to produce and export, the country of origin incur production costs plus transaction costs, therefore, the total costs of exporting are production costs plus bilateral transaction costs. Supposing that a country produces good *l* for export, then total costs of exporting are expressed as follows:

$$TC_{ij}^{l} = \frac{\delta_i}{\eta_i(l)} + t_{ij} = \frac{\delta_i}{\eta_i(l)}\left(1+\gamma_{ij}(l)\right) \quad \text{..... (4)}$$

Where TC_{ij}^{l} is the total costs of exporting good *l* from origin country *i* to destination country *j*, $\frac{\delta_i}{\eta_i(l)}$ is the production cost of good *l* in origin country *i*, t_{ij} the transaction costs of exporting good *l* from origin country *i* to destination country *j* and $\gamma_{ij}(l)$ is the ratio of transaction costs of exporting good *l* from origin country *i* to destination country *j* to production costs.

In the two country *i* and *j* and two products x and y case, country *i* will produce and export x and import y if the relative total costs of producing x is lower than that of country *j* and that the relative costs of producing y by country *j* is lower than that by *i*. This relationship can be expressed as follows:

$$\frac{\frac{\delta_i}{\eta_i(x)}\left(1+\gamma_{ij}(x)\right)}{\frac{\delta_i}{\eta_i(y)}\left(1+\gamma_{ij}(y)\right)} < \frac{\frac{\delta_j}{\eta_j(x)}\left(1+\gamma_{ji}(x)\right)}{\frac{\delta_j}{\eta_j(y)}\left(1+\gamma_{ji}(y)\right)} \quad \text{..... (5)}$$

If equation (5) holds, then international trade of products x and y between country *i* and *j* will take place according to the trade theory of comparative advantage. Digital trade facilitation can stimulate bilateral exports through reducing $\gamma_{ij}(x)$. Three policy variables that make up $\gamma_{ij}(x)$ can be manipulated through digital trade facilitation and these are input costs, δ_i, production efficiency, $\eta_i(x)$ and transaction costs t_{ij}.

2.3 Digital Trade Facilitation, Transaction Costs, Input Costs and Production Efficiency

This subsection seeks to answer the question on how digital trade facilitation impacts on unit cost of inputs, production efficiency and transaction costs to stimulate an increase in bilateral trade flows.

2.3.1 Digital Trade Facilitation and Transaction costs

Transaction costs can be defined as all costs incurred to get a product from the factory-gate in the country of origin to the final consumer in the importing country save for the marginal cost of production, (De, 2008). This analysis categorises transaction costs into four dimensions which are trade friction costs, border related costs, transport costs, and behind the border costs (Portugal-Perez & Wilson, 2008 and AfDB, 2010).

2.3.1.1 Trade Friction Costs

Trade friction costs are largely exogenous and they include the geography of trading partners (distance, landlockedness, sharing a border), and different languages among others. This dimension of trade costs traditionally features in gravity models of bilateral trade analysis. Landlocked countries experience higher trade costs relative to their coastal counterparts hence they trade less, (Arvis et al., 2010). Africa has 15 landlocked countries and 8 of them are COMESA Member States, (WCO, 2014; Portugal-Perez & Wilson, 2008), the implication is that about 40% of COMESA Member States experience high trade costs. Trade costs also increase with distance hence countries tend to trade more with their neighbours and less with those that are far. Different languages induce translation costs to traders. Digital trade facilitation cannot change the distance between countries nor transform a landlocked country into a coastal country. Digital trade facilitation has no influence to have countries share a border. Due to the nature of these costs, little can be done in terms of application of ICT solutions to reduce them, (WTO, 2017). Developing regional transport infrastructure and regional conventions to guarantee freedom of transit features are mostly among the strategies to address trade friction costs, (Arvis et al., 2010).

2.3.1.2 Border Related Costs

When crossing borders cargo is faced with various costs emanating from customs procedures, complying with various trade policy instruments and non-tariff measures (NTM) that include standards and technical regulations.

2.3.1.2.1 Customs Procedures

Customs administration is responsible for levying import/export duties, verifying goods conformity to national policies and preventing importation/exportation of banned or unsafe goods. Customs clearance procedures generate both direct and indirect costs. Direct costs include clearance transaction costs, documents preparation, printing and delivery costs, duty payment, labour payments for off-loading and loading at search bays and bond fees among others. Indirect costs are a result of delays at border posts. Delays induce storage, demurrage, and driver upkeep costs. They also result in high stock holding costs besides the opportunity costs of money tied up in stocks. Whilst digital trade facilitation can do little to reduce direct costs

such as statutory fees, it has been very instrumental in enabling the implementation of modern customs procedures such as electronic pre-arrival processing, automated risk management, electronic single window system, electronic cargo tracking and tracing, e-payment and non-intrusive search technologies which reduce delays and therefore indirect costs.

Electronic pre-arrival processing refers to the electronic submission of customs declaration and supporting documents prior to goods arrival at the border. This has been enabled by the use of internet and electronic data interchange (EDI) systems such as the web-based ASYCUDA World system. This saves on border waiting time as documents are processed before the cargo arrives at the border. The use of electronic documents also saves the costs of preparing and delivering physical documents. However, most customs administration in developing countries keep the mandatory requirement to submit original documents for verification purposes. In such cases, the advance electronic submission of information adds another layer to the existing complex procedures instead of streamlining them. Thus, the effect of automation on this component of trade costs and hence on bilateral trade depends on whether the mandatory requirement to submit original documents is removed or not. Electronic documents will always be accompanied by paper documents if there is no legal framework recognising their legal status, (OECD, 2005).

Application of ICT to customs procedures enabled the automation of risk management which rides on the pre-arrival submission of electronic documents. EDI systems such as the ASYCUDA World system have an embedded selectivity module which profile cargo on risk basis enabling customs to concentrate their resources on high risky cargo while expediting release of less risky cargo. The selectivity module automatically extracts data variables from the electronically submitted declaration. The data variables may include the product, importer/exporter, shipping company and the country of origin. The module then assigns a vector of predetermined weights to these variables and generates risk scores. Based on the scores, the shipment is either classified risky or low risky (Fernandes, Hillberry, & Alcántara, 2015)

Whilst automated risk management presents great opportunities to reduce border crossing times and hence costs, these opportunities are not realised in most developing countries as the ICT solutions are not supported by physical infrastructure. Risk management employ the principle of separation of traffic and thus requires infrastructure that separate traffic at border posts. For example, cargo that is routed green (less risky) may fail to secure a free passage at Beitbridge Border Posts that have only one lane for all commercial trucks. Furthermore, there are other government border agencies with varying definition of risk to that of customs. These, in most cases, maintain a separate risk management system and are often not interfaced with the customs EDI system, hence, they are not able to access electronic documents submitted to customs prior to arrival of cargo at the border. This disintegration of systems results in uncoordinated interventions by various agencies in effecting controls defeating the efficiency gained through automation. Therefore, one cannot say with certainty that the customs automated risk management system will lead to a decline in trade costs and hence stimulate trade.

Electronic single window (ESW) systems provide solution to streamlining customs procedures and reducing coordination costs among various trade stakeholders. Among other things, ESW system enables integrated risk management, processing of different procedures in parallel which

helps save time, and reduce the traders interface with officials. ESW system enables traders to lodge information with a single body/window to fulfil all trade related regulatory requirements. There are different types of ESW systems and their impact on trade costs are expected to vary. One way is to have one agency for example customs, perform a number of tasks on behalf of other government agencies, a system in use in Netherlands and Sweden. Second is a system that provides an entry through which traders communicate with different systems of different government agencies and this has been implemented in Mauritius and Singapore. The third is a single integrated system that allows traders to submit standardised data only once so that the system distributes them to related agencies. Such an integrated system has been implemented in Japan, (OECD, 2005).

ICT application in trade facilitation has enabled customs transit management through electronic cargo tracking and tracing, reduction in search delays through the use of non-intrusive search technology, and greatly reduced the costs of information through internet publishing of trade related documents and regulatory requirements.

2.3.1.2.2 Trade Policy, Standards and Technical Regulations

Trade policy costs such as tariffs have been greatly reduced either through unilateral or multilateral frameworks to the extent that they are not significant barriers to trade. Even though, application of ICT does not have any influence on duty rates, use of import licenses reduces the economies of shipment scale besides the time consuming processes of obtaining the license. Whilst digital trade facilitation can reduce the costs of obtaining import licenses through online application and issue (e-licensing), it cannot reduce the costs incurred due to importing/exporting restricted quantities.

Product standards and technical regulation affect both production and transaction costs. They can impose additional fixed or variable production costs in cases where there is need to alter production process to meet standards and regulatory requirements in the importing country. The certification to demonstrate compliance adds to the trading costs as the certificates are mostly in paper form and takes time to process. Digital application, issue and transfer of electronic sanitary and phytosanitary certificates and certificates of origin could greatly reduce trading costs, (OECD, 2005). Alternatively, product standards and technical regulation in the importing country can reduce transaction costs through providing information about consumer taste and industry needs, information which would costs exporters.

2.3.1.3 Transport Costs

This is one of the major components of transaction costs. It is most pronounced in landlocked countries. Transport costs affect internet traded goods in the similar way as traditionally traded goods as their distribution is also largely a physical process (Meltzer, 2015). A number of factors influence transport costs and these include: the geography of trading partners; demand for transport services; number of transport service providers; size of shipment; trade volume; quality of infrastructure; trade imbalance resulting in empty return loads; type and value of goods; transport market structure (competition and regulations); transit times; fuel prices; drivers and assistance wages; and capital expense (depreciation) among others. Border and

behind the border trade costs also have an indirect impact on transport costs. They increase costs leading to low trade volumes which subsequently reduce demand for transport services. Digital trade facilitation can reduce transport costs through manipulating a few of the transport costs determinants which in broad sense are border and behind the border related costs. A net decrease in transport costs as a result of digital trade facilitation can only occur if the increase in transport costs due to other determinants is less than the decrease effected by digital trade facilitation.

2.3.1.4 Behind the Border Costs

This dimension considers social infrastructure as a key component of transaction costs. Social infrastructure refers to institutions and their status as reflected in the quality of governance, transparency, rule of law and the business environment. Weak institutions affect transaction costs in various ways. Firstly, they lead to poor supply of quantity and quality public goods such as roads, railways and port infrastructure. Secondly, trade transactions are inherently risky under weak institution regime due to lack of contract enforcement. Thirdly, governments with weak institutions often have small tax revenue base and therefore resort to import duty revenue to finance their expenditure. In such cases, border management approaches are characterised by a gate keeping philosophy to maximise collections, which induces a lot of delays at border posts. Last but not least, weak institutions are exhibited by rampant corruption at various steps along the supply chain for example at border posts, roadblocks and at weigh bridges. Corruption increases trade costs as unofficial payments are made to secure quick passage.

Digital trade facilitation improves transparency by removing human discretion through enabling uniform application of trade formalities and regulations. The minimisation of trader interface with officials through the use of electronic documents and the single window system decreases corruption incidences. However, application of ICT in facilitating trade cannot influence rule of law and guarantee contract enforcement thereof. In addition, it cannot influence government to prioritise the provision of right quantity and quality of trade related physical infrastructure.

2.3.2 Digital Trade Facilitation, Input Costs and Production Efficiency

Streamlining customs and other border agencies trade related procedures through the application of ICT solutions such as Electronic Data Interchange (EDI) and electronic single window systems reduce the time cargo spends at the border. This reduces transaction costs enabling firms easier access to cheaper raw materials, capital machinery/equipment, new innovations and technology with spillovers into the wider economy, consequently reducing production costs, and boosting output for both export and domestic markets, (Romer, 1990; Spence & Karingi, 2011). Firms will be able to increase their productivity as they can produce more at same costs or the same output at less costs. Digital trade facilitation also has potential to improve logistics services and lower transport and communication costs, as demonstrated in subsection 2.3.13. This enables firms to participate in global supply chains, specialising in tasks rather than final products. Thus, goods move across many borders as value is being added before reaching the final market, (UNCTAD, 2016). The effect of digital trade facilitation on input costs and production efficiency is therefore on condition that it has managed to reduce transaction costs.

Theoretical analysis has identified three variables through which digital trade facilitation can influence exports namely input costs, production efficiency and transaction costs. Transaction costs are categorised into trade friction costs, border related costs, transport costs and behind the border costs. Theoretically, digital trade facilitation seems to have greater potential to reduce border related costs. Marginal effects are expected on transport costs and behind the border costs while there is no effect on trade friction costs. The effect on input costs and production efficiency is on condition that digital trade facilitation manages to reduce transaction costs. In order for digital trade facilitation to induce a net decrease in total transaction costs the increase in transaction costs due to all other factors must be less than the decrease in trade costs induced by digital trade facilitation in absolute terms. Therefore, this analysis concludes that though digital trade facilitation has potential to reduce transaction costs, it is not a panacea to this problem; hence its impact on bilateral trade remains ambiguous, at least on theoretical basis.

2.4 Empirical Literature Review

Although trade facilitation can be traced back to GATT 1994 Articles V, VIII and X, empirical literature on the economic impact of digital trade facilitation is fairly new. Most cited evidence in support of implementing digital trade facilitation show the impact on time and costs to trade. Evidence on their influence on trade flows is very scarce. Duval, Utoktham, & Kravchenko (2018) using averages of data for 2013 to 2015, employed the gravity model to assess the impact of digital trade facilitation on trade costs for a sample of 96 countries among them nine COMESA Member States. They found that if both trading partners increase implementation of paperless trade facilitation by 10%, it would reduce trade costs by 1.4%. Of the 1.4% decrease in trade costs, 0.9% was attributed to the reporting country, while the remaining 0.5% was due to the trading partner's increase in implementation of paperless trade facilitation. They modelled trade costs by trade friction, cultural factors, trade policy and behind the border factors.

Tinatin & Katarzyna, (n.d) estimated the impact of internet and ICTs use on European Union (EU) exports for the period 1999 to 2014, using a gravity model and the Poisson pseudo-maximum-likelihood (PPML) estimator. They found that a 1% increase in internet and ICTs use was associated with 0.33% and 0.16% increase in EU exports respectively. They controlled for trade costs with trade friction costs in their model.

Portugal-Perez & Wilson, (2008), developed four trade facilitation indicators for the period 2004-2007 and used the gravity model to assess their impact on export perfomance of 101 countries, nine of them COMESA Member States. The information and communication technology (ICT) variable (the extent to which an economy uses ICT to improve efficiency and productivity and reduce transaction costs), had significant positive impact on exports, however, the impact seemed more increasingly important for developed countries.

Fernandes, Hillberry, & Alcántara, (2015) employed the instrumental variable (IV) estimation technique on transaction level import data for Albania spaning the period 2007 to 2012 to investigate the impact of automated risk management on the probability of a consignment being searched and the resultant effect on import flows. They found that implementation of automated risk management led to the fall in the probability that a shipment will undergo inspection by 50% and this reduced the average days spent at Albanian customs by 7% which culminated into a 7% increase in import flows.

Shepherd & Duval, (2014) using 2013 data for a sample of 29 Asia-Pacific region countries, estimated the impact of implementing cross border paperless trade reforms on trade times with ordinary least squares estimator and employed simulations to generate the subsequent export gains. They obtained the time elasticity of trade from literature. Their results indicated that if all 29 countries partially implemented paperless cross border reforms, the region would gain US$36 billion annually in exports. Full implementation was associated with regional export gains of US$257 billion annually.

In both Tinatin & Katarzyna, (n.d) and Portugal-Perez & Wilson, (2008), the ICT variable is defined as the extent to which an economy uses ICT to improve efficiency and productivity and reduce transaction costs. The ICT varible in Portugal-Perez & Wilson, (2008) particulary captures availability, use, absorption, and government prioritisation of ICT. This study deviate from Tinatin & Katarzyna, (n.d) and Portugal-Perez & Wilson, (2008) in two dimensions with regard the ICT variable. Firstly, this study is assessing the impact of implementation level of ICT solutions. Secondly, this study's scope of ICT applications is only to simplify and automate procedures related to trading across borders and not the overal economy.

Whilst Fernandes, Hillberry, & Alcántara, (2015) focuses on a single parameter of digital trade facilitation, the study by Shepherd & Duval, (2014) captures the implementation of digital trade facilitation in the exact sense of this study. Hower, Shepherd & Duval, (2014) analysis only captured export gains resulting from unilateral implementation of paperless trade reforms ignoring the gains that acrue when the trading partner reforms reciprocally. In a bilateral trade scenario, trade costs are generated in both the origin and destination country, thus, the origin country also benefit from trade facilitation reforms implemented by the destination country, (Duval, Utoktham, & Kravchenko, 2018). This study will therefore capture both sources of trade gain. This study also differ from Shepherd & Duval, (2014) in that it directly estimates the digital trade facilitation implementation export elasticity using a gravity model.

3.0 Methodology

The methodology adopted in this study is in two parts. The first part used the Structural Gravity Model to estimate the impact of implementing digital trade facilitation. This provides the impact on intra-COMESA exports generated by the current implementation level of digital trade facilitation. The second part employs counterfactual analysis to generate possible intra-COMESA exports gains that may result when all Member States fully implement digital trade facilitation reforms.

3.1 Gravity Model Specification

The gravity model postulates that trade between two countries is proportional to the product of their Gross Domestic Product (GDP) and inversely proportional to distance between them. Distance is broadly construed to represent trade costs. Following Silva & Tenreyro, (2006), this study estimated the empirical model (6) using cross sectional data for the year 2016 for COMESA Member States. Data on digital trade facilitation is only available for one year, thus, a panel data analysis is not possible in this study.

$$X_{ij} = \exp(\beta_0 + \beta_1 GDP_i + \beta_2 GDP_j + \beta_3 Dist_{ij} + \beta_4 Contig_{ij} + \beta_5 Comlang - off_{ij} + \beta_6 Comcol_{ij} + \beta_7 Landlocked + \beta_8 RQ_i + \beta_9 ROL_i + \beta_{10} Ex\Delta\_Rate_i + \beta_{11} DTF_i + \beta_{12} DTF_j + \varepsilon_{ij} \quad \text{.....6}$$

Where β_i are parameters to be estimates and ε_{ij} is the white noise error term. All variables are defined in Table 2:

Table 2: Variable Definition, Data Source and Expected Sign

Variable	Definition	Expected sign	Source of Data.
X_{ij}	Exports of goods and services from country i to country j. The dependent variable	-	World Integrated Trade Solutions (WITS)
GDP_i	Exporter Gross Domestic Product	+	World Development Indicators (WDI)
GDP_j	Importer Gross Domestic Product	+	World Development Indicators (WDI)
$Dist_{ij}$	Geographical distance between country i and j	_	Centre d'Etudes Prospectives et d'Informations Internationales (CEPII)
$Contig_{ij}$	1 if country i and j share a common border and zero otherwise	+	Centre d'Etudes Prospectives et d'Informations Internationales (CEPII)
$Comlang\_off_{ij}$	1 if country i and j use the same common official language and zero otherwise	+	Centre d'Etudes Prospectives et d'Informations Internationales (CEPII)
$Comcol_{ij}$	1 if country i and j had a common colonizer after 1945 and zero otherwise.	+	Centre d'Etudes Prospectives et d'Informations Internationales (CEPII)
$Landlocked_{ij}$	1 if either country i or j is landlocked and zero otherwise	-	Centre d'Etudes Prospectives et d'Informations Internationales (CEPII)
RQ_i	Regulatory Quality for country i	+	World Governance Indicators (WGI)
ROL_i	Rule of law for country i	+	World Governance Indicators (WGI)
$Ex\Delta\_Rate_i$	Exchange rate of the exporting country to the US$	-	Africa Trade Report by AFREXIM Bank
DTF_i	Digital trade facilitation implementation score by country i	+	Author calculated using data from World Bank Trading Across Borders

DTF_j	Digital trade facilitation implementation score by country j	+	Author calculated using data from World Bank Trading Across Borders

Our empirical model was estimated in its multiplicative form using the Poisson pseudo-maximum-likelihood (PPML) estimator in order to handle the zero observations in our trade data whilst ensuring consistence of estimated parameters in the presence of heteroscedasticity. Importer and exporter fixed effects were used to control for unobserved heterogeneity and improve efficiency.

3.1.2 Construction of the Digital Trade Facilitation Implementation Score (DTF variable)

Using the World Bank Trading Across Borders Electronic Platforms Dataset, this study adopted the methodology developed by Shepherd & Duval, (2014), and constructed a simple index that capture the level of implementation of digital trade facilitation by all COMESA Member States The Electronic Platforms Dataset provides qualitative data regarding implementation of customs electronic data interchange (EDI) systems and single window (SW) systems.

EDI system is considered "operational" if:

i. The electronic platform is functional with minimum glitches;
ii. It allows electronic submission of declarations; and
iii. Electronically connects customs authorities to clearing agencies.

EDI system is considered "in progress" if there exist an EDI that does not meet the operational criterion. EDI is considered "no EDI" if the operational and the "In progress" criterion are not met.

Regarding single window system, it is considered "operational" if:

i. The electronic platform is functional with minimal glitches;
ii. It has an official name;
iii. Accessible through an official and working website;
iv. Allows electronic submission of declarations;
v. Partially completes customs clearance;
vi. Electronically connects customs authorities to clearing agencies;
vii. Electronically integrates or connect customs to other government border agencies, importers, exporters, banks and transporters among other stakeholders

Single window system is considered "in progress" if there exist a single window system that does not meet the operational criterion and it is considered "no single window" if the operational and the "In progress" criterions are not met.

This research summarised the given criterions, and proposed the following:

a) Full implementation corresponds to "operational criterion", partial implementation corresponds to "in progress criterion" and zero implementation corresponds to no EDI or single window system.
b) If a country has fully implemented both EDI and electronic single window systems, it would has satisfied the following measures;

i. Electronic automated customs system established;
ii. Electronic submission of trade related documents;
iii. Electronic single window system established;
iv. Electronically connects customs authorities to clearing agencies;
v. Partially completion of customs clearance electronically;
vi. Electronically integrates or connect customs to other government border agencies, importers, exporters, banks and transporters among other stakeholders.

c) If a country fully implements the EDI system only, it has satisfied measures i, ii, and iv.

d) Partial implementation of EDI system only satisfies measures i.

The logic of implementation assumed here is that a country implements EDI system first. This will be followed by implementing an electronic national single window system and finally implements a regional electronic single window system. The first 3 measures also correspond to paperless trade measures in Table 1 by Duval & Kravchenko, (2017).

The qualitative data was quantified by applying a simple scale. No implementation corresponds to zero. Partial implementation corresponds to 0.5 and full implementation corresponds to 1. Using this transformation of data, a score for each COMESA Member State on the six measures of digital trade facilitation implementation was estimated with a maximum of six indicating full implementation of all measures. All the six measures used do not capture the cross border paperless trade. They capture the coodination and exchange of data and documents among government border agencies and business community within a country.

3.2 Counterfactual Analysis

The counterfactual simulations considered two scenarios and three estimation steps:

Scenarios:

i. All COMESA Member States achieve at least 50% implementation of the six measures of digital trade facilitation.
ii. All COMESA Member States achieve full implementation of the six measures of digital trade facilitation.

Estimation steps:

i. Counterfactual implementation scores corresponding to the two scenarios were calculated;
ii. Changes between baseline and counterfactual implementation scores were calculated and expressed as a percentage of the baseline score; and
iii. Percentage changes in implementation scores were translated into percentage changes in intra-COMESA exports using the implementation elasticities estimated in the empirical model (6) which are presented in Table 4.

4.0 Estimation and Discussion of Results

This section presents the results of applying the methodology developed in Section 3. Preliminary

diagnostic test in the form of correlation analysis to assess the possibility of multicollinearity are presented first followed by descriptive analysis. The section proceeds with presentation of the empirical results and counterfactual analysis. Discussion of the overall results concludes the section.

4.1 Diagnostic Tests Results

4.1.1 Correlation Analysis

Correlation analysis results indicates that the rule of law and regulatory quality variables are highly correlated. Thus, to avoid multicollinearity, this study only used the regulatory quality of both the exporter and the importer in estimating equation (6).

4.1.2 Descriptive Statistics

Table 3, summarises export flows and digital trade facilitation implementation scores for COMESA Members States. Bilateral export flows in COMESA averaged US$16.8 million for the year 2016. A minimum of zero export flows explains greater variability of export flows among COMESA Member States when compared to a maximum export flow of US$545 million. Average baseline digital trade facilitation implementation score is estimated to be 3.6 out of a total of 6 scores. Implementation levels vary from one country to another as shown by a range of 5.5 scores.

Table 3: Descriptive Statistics

Variable	Mean	Std. Dev	Min	Max
X_{ij}	16777.05	61757.55	0	545327.9
DTF_i	3.59375	1.66	0.5	6
DTF_j	3.59375	1.66	0.5	6

4.2 Empirical Results

Table 4, present the results of gravity model analysis. Distance, sharing a border (Contig), and common official language have the correct signs, however, only distance and Conti are strongly significant at 1% level. While common coloniser and landlocked are associated with wrong signs and insignificant, thus, they are not different from zero. Regulatory quality is statistically highly significant at 1% level and carrying the correct sign. The exchange rate variable has a negative relationship with exports though weakly significant at 10% level. The importer variable of digital trade facilitation implementation score is carrying the correct positive sign and highly significant at 1% level. The exporter variable of digital trade facilitation is carrying the wrong sign and is statistically insignificant. Thus, the influence of exporter variable of digital trade facilitation on intra-COMESA exports is not different from zero.

Table 4: Gravity Model Results

VARIABLES	X_{ij}
$Dist_{ij}$	-0.000903***
	(0.000239)
$Contig_{ij}$	1.564***
	(0.403)
$Comlang\_off_{ij}$	0.216
	(0.555)
$Comcol_{ij}$	-0.434
	(0.477)
$Landlocked_{ij}$	0.00174
	(0.445)
RQ_i	0.971***
	(0.297)
$Ex\Delta\_Rate_i$	-0.000252*
	(0.000151)
DTF_i	-0.186
	(0.207)
DTF_j	0.546***
	(0.143)
β_0	8.938***
	(2.206)
Observations	224
R-squared	0.932

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

An increase of 1% in the importer digital trade facilitation implementation score is associated with a 0.55% increase in intra-COMESA exports. This effect on intra-COMESA exports is equivalent to what can be generated by a 10.4% reduction in ad-valorem tariff[1]. It is not surprising that the effects of exporter variable for digital trade facilitation is not different from zero from the intuition that most COMESA Member States relies on customs duty for revenue thus they tend to subject exports to less scrutiny whilst subjecting imports to multiple complex procedures. Implementing digital trade facilitation is, therefore, expected to have a greater

1 The value of elasticity of substitution used is 5 and has been extracted from Yotov et al., (2017).

effect on harmonising and streamlining importer procedures and formalities relative to exporter procedures and formalities.

4.3 Counterfactual Simulations Results

The counterfactual results are given in Annex 1. Scenario 1 simulations show that if all COMESA Member States implement 50% of digital trade facilitation reforms the region would gain intra-COMESA exports of US$ 5.9 billion annually. The second scenario simulations indicate that if all COMESA Member States fully implement digital trade facilitation reforms, the region would annually gain US$ 12.3 billion in intra-COMESA exports.

4.4 Discussion of Results

This study established that scaling up implementation of digital trade facilitation would stimulate intra-COMESA exports. A 1% increase in implementation score would result in 0.55% increase in intra-COMESA exports. Partial implementation of digital trade facilitation by all COMESA Member States would result in annual intra-exports gains of US$ 5.9 billion. On a more ambitious scenario of full implementation of digital trade facilitation by all Member States, the region would gain annual intra-exports of US$ 12.3 billion. These results corroborate with those established by Shepherd & Duval, (2014) in Asia and the pacific region where they established that if all 29 Asia-Pacific region countries partially implemented digital trade facilitation reforms, the region would gain US$36 billion annually in exports whilst full implementation was associated with regional export gains of US$257 billion annually.

The regional average implementation score of 3.6 out of a total of 6 scores demonstrates the existence of great potential to scale up implementation. The range of 5.5 in implementation scores is suggestive of greater variability of implementation from one country to another. The implication is that countries face varying implementation challenges and that one size fit all approach to policy reform may not work for COMESA region. Counterfactual simulation results in Annex 1 show that more intra-exports gains will be generated from Member States with a low baseline implementation score. Eritrea, Egypt, Sudan, Libya and Ethiopia have very low baseline implementation score. Comoros, DRC, Djibouti, Malawi, Eswatini, Seychelles, Uganda, Zambia and Zimbabwe have medium implementation scores. Kenya, Madagascar, Mauritius and Rwanda have fully implemented the six measures considered hence they have maximum scores of 6 each. These have exhausted their potential to generate additional intra-COMESA exports with respect to scaling up implementation of the six paperless trade facilitation measures considered in this study.

Policy needs to be directed towards getting the countries with low to medium baseline implementation scores scale up implementation of digital trade facilitation in order for the region to realise the demonstrated potential benefits. Efforts should be made to understand country specific circumstance on why they have not been able to scale up implementation.

The implementation scores used in this study only captured the paperless trade facilitation measures that enable efficient coodination and exchange of data and documents among government border agencies and business community within a country. Thus, this study did not analyse the impact of paperless cross border trade facilitation measures given on the right

hand side of Table 1. These forms the basic building blocks for exchange and mutual recognition of electronic trade data and documents along the entire international supply chain or between countries, (Duval & Mengjing, 2017). In that context, policy direction for Kenya, Madagascar, Mauritius and Rwanda who have maximum scores on the six meaures considered in this study can focus towards implementation of paperless cross border trade facilitation measures.

5.0 Conclusion and Policy Implications

This study analysed the impact of implementing digital trade facilitation on intra-COMESA exports. The findings imply that implementation of digital trade facilitation reforms need to be prioritised though they are not mandatory in regional and multilateral legal frameworks. Whilst COMESA Member States need to scale up the implementation of digital trade facilitation reforms (EDI and ESW systems in particular) in order to increase their intra-exports, one size fit all policies may not work as there is greater variability in baseline implementation levels. Variability in baseline score imply that gains from implementation also vary from one country to another as demonstrated in Annex 1. Thus, COMESA should encourage Member States with low implementation score to speed up implement as they have greater potential to gain.

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Annex

Annex 1: Counterfactual Simulations Results

#	COMESA member states	Baseline Exports to COMESA in 2016: US$ (000)	Scenario1: Partial Implementation			Scenario 2: Full Implementation		
			%△in Digital TF implementation	Simulated annual %△ in exports to COMESA	Simulated annual gains in exports to COMESA: US$ (000)	%△ in Digital TF implementation	Simulated annual %△ in exports to COMESA	Simulated annual gains in exports to COMESA: US$ (000)
1	Burundi	51090.216	28.57142857	15.7	8021.16	71.42857	39.3	20078.45
2	Comoros	3408.807	50	27.5	937.42	100	55	1874.84
3	DRC	17402.914	28.57142857	15.7	273225.75	71.42857	39.3	6839.35
4	Djibouti	179.783	50	27.5	49.445	100	55	98.88
5	Egypt	1787786.36	500	275	4916412.49	1100	605	10816107.48
6	Eritrea	3789.508	600	330	12505.38	1200	660	25010.75
7	Ethiopia	11711.517	600	330	38648.00	1200	660	77296.01
8	Kenya	965328.329	0	0	0	0	0	0
9	Libya	68409.111	600	330	225750.07	1200	660	451500.13
10	Madagascar	70956.168	0	0	0	0	0	0
11	Malawi	56758.016	28.57142857	15.7	8911.01	71.42857	39.3	22305.9
12	Mauritius	201337.527	0	0	0	0	0	0
13	Rwanda	156635.993	0	0	0	0	0	0
14	Sudan	45931.768	500	275	126312.36	1100	605	277887.2
15	Eswatini	84656.289	50	27.5	23280.48	100	55	46560.96
16	Seychelles	83968.087	50	27.5	23091.22	100	55	46182.45
17	Uganda	782633.329	28.57142857	15.7	122873.43	71.42857	39.3	307574.9
18	Zambia	361215.258	28.57142857	15.7	56710.80	71.42857	39.3	141957.6
19	Zimbabwe	92639.086	50	27.5	25475.75	100	55	50951.5
	TOTAL	**4845838.065**			**5862205**			**12292226.4**

Effect of Demographic Transition on Manufacturing Sector within the Common Market for Eastern and Southern Africa Region

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Abstract

This study investigated the effects of demographic transition on manufacturing sector in COMESA region. The study adopted the Solow-Swan model and applied the Ordinary Least Squares method to establish the effect of changes in the population age structure on manufacturing sector growth within COMESA region. The study found that working age population and gross capital formation positively influenced the value added in manufacturing while Gross Domestic Product per capita did not significantly affect manufacturing value added. However, the share of women in working age population had a negative effect on manufacturing value added. Based on the findings, COMESA Member States should focus on implementing strategies to increase the working age population in order to enhance performance in the manufacturing sector. Further, the study recommends collaboration between the governments and the private sector towards creating an enabling environment that promotes capital formation in the private sector within the region. In addition, Member States should directly contribute to capital formation by increasing spending on infrastructure. Lastly, there is need for further research to establish the cause of the inverse relationship between the manufacturing value added and share of women in working age population.

1.0 Introduction

1.1 Background

African economies experienced unprecedented rates of economic growth as well as rapid urbanization between 2005 and 2015 (Hazell, 2017). The continents population continues to expand rapidly. The World Bank projects that Africa's population will hit 2.8 billion people by 2060. Within Africa, the Common Market for Eastern and Sothern Africa (COMESA) is one of the largest Regional Economic Communities (RECs). African Development Bank Group (ADBG) statistics indicate that the region's total population is over 570 million people with Gross Domestic Product (GDP) of over 943 billion US dollars as of 2017. The population continues to grow rapidly drawing the attention of many policy makers and demographic researchers. Similarly, over the last decade, the region has recorded economic growth rates above the global average making it and the continent the new economic growth frontier within the global economy.

According to Canning et al. (2015) there has been a surge in the numbers of youth with an average of 60 percent of the total population being below the age of 24 years. Similarly, the number of people aged between 15 and 64 years has increased rapidly. Each age bracket in a population has unique characteristics, with distinct economic effects: the young (below 15 years of age) require heavy investment in education and health; adults (between 15 and 64 years) supply labour and savings; and the aged (65 years and above) require health care and retirement income. Bloom (2011) attributes the demographic transition to changes that a country undergoes from a regime of high fertility and high mortality to one of low fertility and low mortality. Changes in the birth and fertility rates lead to transformation of the population which impact on the country's prospects for growth and socio-economic development. Specifically, as the fertility and birth rates fall, fewer investments are required to meet the needs of the young population groups and therefore resources are released for savings and investment. At the same time, there is an increase in the number of labourers within the economy (Ross, 2004). Ultimately, the dependency ratio falls and with the lower burdens on families, the households will further increase their savings leading to higher investments (capital formation) and faster economic growth. These benefits that arise from the change in population structure are referred to as demographic dividends.

Demographic dividends are composite of five distinct forces (Bloom, 2011). The first is the increase in labour force as the baby boomers reach working age. This is followed by the ability to divert social resources from investing in children to investing in physical capital, job training, and technological progress. The third force emanates from the rise in women's workforce activity which naturally causes a decline in fertility. The fourth links the working age population to the prime years of savings, which is key to the accumulation of physical and human capital and technological innovation. Lastly, the boost to savings hence capital formation that occurs as the incentive to save for longer periods of retirement increases with greater longevity.

Acccording to Ross (2004), as fertility rates fall during the demographic transition (provided that countries act wisely before and during the transition), a special window opens up for faster economic growth and human development. Some of the areas that require action before and during the window of opportunity include sectors that open up the economy for more jobs like agriculture, manufacturing, trade, services and mining as well as institutional reforms that make

it possible for investment in all the sectors to be optimal. Benchmarking from the experience of Asian countries like; South Korea, Singapore, Hong Kong, Taiwan, China and India, policy choices can spur COMESA's potential for realization of economic benefits stemming from demographic change.

One of the most critical sectors that provide such potential is the manufacturing sector. Globally, there has been transformation in manufacturing due to advancement in technology, rise of global value chains, outsourcing by multinational companies, global competition and regional integration (COMESA Business Council, 2013).

The growth of manufacturing sector in Africa however, has been at a sluggish pace as illustrated in Table 1.

1.2 The Manufacturing Sector in COMESA

The manufacturing sector plays a fundamental role in intra-trade and economic growth of the COMESA region. The sector is primarily centered along the sub-sectors of food and beverages, tobacco, wood, paper, refined petroleum and coke, cement, rubber and plastics, glass and other nonmetallic metals, basic metals, fabricated metals, textiles and apparel, leather, publishing and printing, furniture, chemicals, machinery and equipment.

According to the COMESA Business Council (2013), the value of COMESA's manufacturing industry remains low and its importance is being overridden by the agriculture, services and mining sectors in most countries. Table 1 shows the decline of manufacturing value added as a proportion of the GDP over the past decade for most of the Member States.

Table 1: Manufacturing, Value Added (Percentage of GDP)

Country Name	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Burundi	12.07	10.49	10.65	10.14	9.67	9.12	9.46	9.75	9.57	10.08
Congo, Dem. Rep.	20.71	23.41	25.1	17.85	17.58	17.36	17.65	17.75	17.05	19.32
Comoros	-	-	-	-	-	-	-	-	-	-
Djibouti	2.45	-	-	-	-	-	-	-	-	-
Egypt, Arab Rep.	16.11	16.25	16.55	16.89	16.5	15.8	16.05	16.2	16.5	17.07
Eritrea	5.71	6.76	5.65	-	-	-	-	-	-	-
Ethiopia	4.93	4.4	4.11	4.29	3.99	3.7	4.03	4.34	4.79	4.34
Kenya	14.46	13.58	13.39	12.62	13.08	12.25	11.88	11.02	10.33	10.03
Libya	4.51	4.49	-	-	-	-	-	-	-	-
Madagascar	14.47	14.35	-	-	-	-	-	-	-	-
Mauritius	17.41	17.2	16.66	15.92	15.67	15.47	15.74	15.31	14.7	13.91

Malawi	15.49	12.64	11.19	10.68	10.94	10	10.26	10.25	10.38	10.3
Rwanda	5.96	6.05	6.54	6.7	6.55	6.44	6.29	6.33	6.35	6.26
Sudan	6.17	5.64	6	5.94	6.33	-	-	-	-	-
Eswatini	36.57	36.11	36.35	34.04	33.26	33.39	31.77	32.86	33.92	33.23
Seychelles	11.03	10.83	9.24	9.65	8.84	9.42	9.11	8.45	-	-
Uganda	7.56	7.77	9.11	9.16	10.58	11.31	10.28	9.19	9.47	9.5
Zambia	9.49	9.24	9.31	8.02	7.96	7.49	6.59	7.31	7.93	8.07
Zimbabwe	16.4	16.66	14.28	12.59	12.26	11.37	10.78	10.32	9.83	9.55
Average Values	12.3	12.7	12.9	12.5	12.4	12.5	12.3	12.2	12.6	12.6

Source: World Development Indicators, World Bank

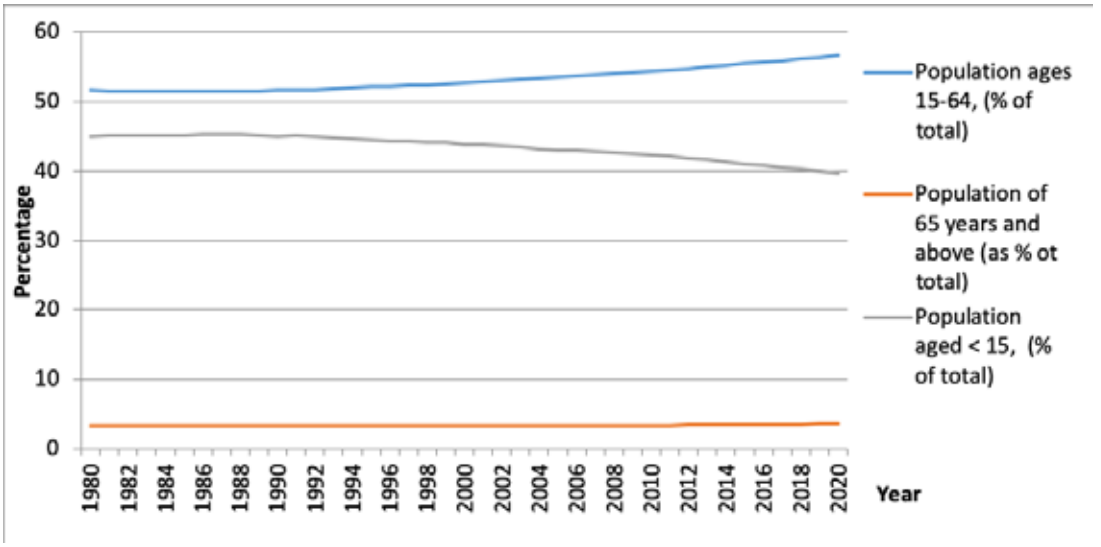
Table 1 shows that Rwanda, Uganda and Egypt recorded a slight increase in manufacturing value added as a share of GDP. The rest of countries experienced a reduction over the period 2007 to 2016. Zimbabwe reported the highest decline from 16.4 percent to 9.55 percent followed by Malawi which averaged 5.49 percent during the same period. Eswatini recorded the highest contribution averaging 34.15 percent and Ethiopia the lowest at 3.86 percent. On average, manufacturing value added as a percentage of GDP in the region has remained relatively constant over the 10 year period. Despite the slow growth, the sector remains essential due to its potential to create jobs and increase the region's income through intra-trade, exportation of manufactured goods and substitution of some of the imported manufactured goods.

1.3 Demographic Transition within COMESA

COMESA's total population stands at about 570 million people and it is projected to hit 600 million people by 2020 (World Bank, 2017). Ethiopia and Egypt are the most populous countries within COMESA with approximately 112 million and 100 million persons respectively while Comoros and Seychelles are the least populated countries with approximately 883,162 and 98,843 persons respectively. The increase in population may be attributed to declining infant mortality, improved health care, and food security among other factors.

Due to the declining infant mortality, death and fertility rates in the COMESA region, the population structure is undergoing a major transition characterized by an increasing working age population and a declining young dependency population. However, old dependency ratio remains fairly constant (COMSTAT, 2017). Figure 1 shows the trends in population age structure in the region. The trend of the young population (0-14), classified as dependents, has been declining while the old population (65 years and above) has maintained a fairly constant trend from 1980 to date. Further, the percentage of the working age population (15-64 years) maintains an increasing trend, which is a good indicator for the potential of reaping demographic dividends in the region.

Figure 1: Trend in Population Structure in COMESA Region



Source: Compiled based on the COMSTAT, 2017

In comparison with East Asia, the COMESA region lags behind in terms of reduction in mortality and fertility rates. Figures 2(a), 2(b) and 3(a) and 3(b) show the trends for the aforementioned rates for COMESA region and East Asia, respectively. The figures show that COMESA region is more than 30 years behind East Asia in terms of demographic transition. For instance, the mortality rate for COMESA region in 2015 was 47 while East Asia reported the same rate in 1984. This implies that for COMESA to realize demographic dividends in the same way that East Asia nations did, the total fertility and infant mortality rates ought to decline at a higher rate.

Figure 2 (a) COMESA: Infant Mortality Trend. Figure 3(a) East Asia: Infant Mortality Trend

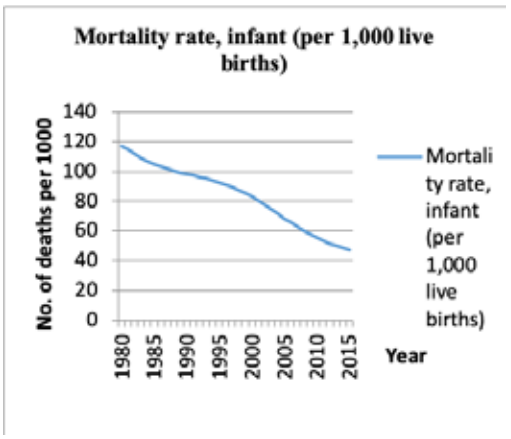
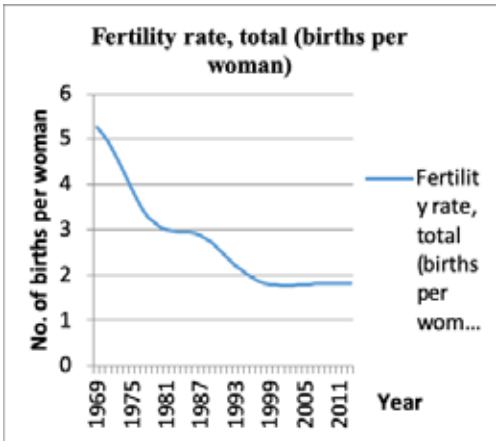
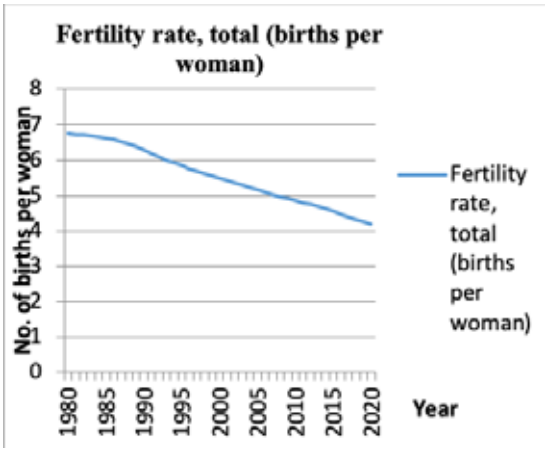


Figure 2(b)COMESA: Trend in Total Fertility Rate. **Figure 3 (b)East Asia: Trend in Total Fertilty**





Source: Compiled based on the COMSTAT, 2017

The changes in the population age structure present an opportunity for the region to benefit from the demographic dividends. COMESA Member States can reap significant benefits from the demographic changes depending on the speed of transition (how fast infant mortality and fertility rates decline) and policy choices. The more rapidly the infant mortality and fertility rates decline, the greater and faster will be the increase in the share of the working age population.

According to Galor and Weil (2000), the increase in per capita income as a result of a rise in the share of the working age population provides a direct channel for realizing demographic dividends. In addition, declining fertility rates are associated with higher female labour force participation rates, which is also an indirect channel for realizing demographic dividends. The reduction in fertility rates among women leads to a decrease in the number of children per household as well as increases in life expectancy. An increase in the number of working individuals as well as enhanced productivity of the workforce leads to increased savings which are further channeled to investments. This promotes economic growth among countries.

1.4 Statement of the Problem

Africa and indeed the COMESA region has experienced significant economic growth as well as demographic change in the last few decades. The total population of the region has not only grown but also, continues to undergo changes in age structure. The share of working age population has been rising as depicted in figure 1. Similarly, the number of women in the working age population as well as that of women who are actively engaged in labour force has been rising (COMSTAT, 2017). At the same time, the value of manufacturing sector within COMESA remains low and the sector has been overshadowed by agriculture, services and mining sectors. World Bank statistics in table 1 indicate that the performance of the sector in terms of value added as a percentage of the GDP has reported dismal growth over the past decade. However, the sector is still essential due to its potential to create job opportunities (for the expanding labour force) and increase the regions income through intra-trade, exportation of manufactured goods and substitution of some of the imported manufactured goods.

Despite the major demographic changes within the region and the lackluster performance of the manufacturing sector, empirical evidence showing how changes in demographics have affected manufacturing sector is inadequate. It is also not empirically established whether COMESA countries have reaped demographic dividend in the manufacturing sector. It is therefore imperative to test the impact of these demographic changes on manufacturing sector performance.

1.5 Objectives of the Study

The general objective of the study is to analyze the effects of demographic transition on manufacturing sector in COMESA region. The specific objectives are:

i. To determine the effect of labour force growth on value added in the manufacturing sector in COMESA region.

ii To establish the relationship between share of females in labour force and value added in the manufacturing sector in COMESA region.

2.0 Review of the Literature

2.1 Theoretical Literature

2.1.1 The Malthusian Theory

The Malthusian theory propounded by Thomas Robert Malthus in 1803, explains the relationship between the growth in both food supply and population. It states that population increases at a geometric progression while food supply increases at an arithmetic progression (Malthus, 1803). This implies that if the population growth is unchecked, it will lead to vice or misery. Malthus proposed that the imbalance between food supply and population could be checked by preventive measures such as late marriage, celibacy and moral restraint. The theory has been criticized because it neglects the manpower aspect in population. For instance, Cannan (1922) criticized the theory on the premise that "a baby comes to the world not only with a mouth and a stomach, but also with a pair of hands."

2.1.2 The Optimum Theory

The theory was propounded by Cannan (1922). Unlike the Malthusian Theory, the Optimum Theory does not establish relationship between population growth and food supply. Rather, it is concerned with the relationship between the size of population and production of wealth. Cannan (1922) states that at any given time, increase of labour up to a certain point is accompanied by increasing proportionate returns and beyond which further increase of labour causes diminishing proportionate returns. The per capita income is highest at the optimal population point where the average product of labour starts falling.

The theory is criticized on the premise that it is impractical to establish the optimum level of population in a country (David & Huang, 1969). According to the authors, the concept of optimum population assumes that the techniques of production, the stock of capital and natural resources, the habits and tastes of the people, the ratio of working population to total population, and

the modes of business organization are constant. However, all these factors are continuously changing hence the optimum population is dynamic.

2.1.3 The Demographic Transition Theory

According to Demographic Transition Theory, every country passes through three distinct stages of population growth (Blacker , 1949). The first stage is characterized by high birth rate and death rate leading to low population growth rate. In the second stage, the birth rate remains stable but the death rate falls rapidly resulting in rapid population growth and in the last stage, the birth rate starts falling and tends to equal the death rate which slows down population growth. The leading growth sectors expand and cause an expansion in output in other sectors through technical transformations. Education expands and permeates the entire society (Kirk, 1996).

The theory is superior to all the theories of population because it is based on the actual population growth trends and is applicable to both developed and developing countries (Kirk, 1996). Therefore, the theory of demographic transition is considered the most acceptable theory of population growth.

2.2 Empirical Literature

There exists a vast body of literature on the impact of demographic transition on the economy. Significant research has also been done on the factors that affect growth in manufacturing/ industrial sector. Empirical literature on demographic dividend for African countries and specifically COMESA is quite scanty.

Rosado and Sanchez (2017) studied the relationship between the dependency ratio, savings rate and real GDP in Ecuador for the period 1975–2015. They used dynamic ordinary least squares (DOLS) and fully modified ordinary least squares (FMOLS) to show the relationship between the variables in the long-run. The overall result indicated that changes in population age structure had a significant impact on real GDP per capita and savings rate in Ecuador.

The study by Doker, Turkem and Emsen (2016) aimed at eastablishing the relatiosnhip between demographic transition and savings within transition economies. Using panel data analysis of 20 transition economies and relying on dependency ratio (total, youth and old), GDP per capita growth, population density, urban population of percentage of total population, female participation of labour force, unemployment rate as variables, the study found that female participation in labour force has positive effect on savings. In addition, the study found that dependency ratio in total has a positive impact on savings.

In analyzing labour productivity in Kenyan manufacturing and service industries, Heshmati and Rashidghalam, (2016) used the World Bank's Enterprise Survey's database for 2013. Using production function approach and OLS they found that capital intensity and wage had a significant and positive effect on labour productivity. In addition, they found that higher female share in the labour force reduced labour productivity whereas, training and education resulted to higher labour productivity.

Canning et al, (2015) studied the economic effects of the demographic dividend in Africa using

data for Nigeria with simulation analysis technique. The model sought to identify the channels through which fertility rate affects economic growth. The study found that demographic change affects the economy through age structure and labour force participation. Increase in the size of the workforce per capita stem primarily from two sources; change in the age structure of the population, which determines the ratio of working-age people to total population and change in labour force participation among men and women.

Thuku, Gachanja and Almadi (2013) sought to establish the impact of population change on economic growth in Kenya. The paper adopted the Solow Swan Model of growth taking the rates of saving, population growth and technical progress as exogenous variables. The study employed Vector Autoregression (VAR) estimation technique and used annual times series data from 1963 to 2009. Their results indicated that population growth and economic growth are positively related. An increase in population was found to positively impact economic growth in the country.

In their analysis of the effects of female labour force participation on manufacturing sector in the Middle East and North Africa regions, Fakih and Ghazalian (2013) used data derived from the World Bank's Enterprise Surveys and applied fractional logit models to carry out the estimations. Their findings indicated a positive effect for many firm related factors, mainly private foreign ownership, exporting activities, and Female Labour Force Participation (FLFP) rates. National factors, such as economic development and gender equality, were also found to promote FLFP rates.

Bloom et al, (2007) tested whether the determinants of growth in general, and the effects of demography in particular were different in Africa from the rest of the world. They estimated using OLS the basic relationship between demography and economic growth on one part and used the estimated coefficients in combination with population forecasts from the United Nations to gauge the magnitude of demographic dividends in Sub-Saharan countries in the second part. Their results indicated that growth in share of working age population significantly influenced economic growth but subject to the presence of good institutions. Further, they found no evidence for the assertion that the experience of Africa is different from the rest of the world.

Bloom and Williamson (1998) introduced demographic variables into the empirical model of economic growth to establish the demographic transitions and economic miracles in emerging Asia. The study applied the Ordinary Least Square on a sample of 78 economies. Their findings indicated that population growth had a purely transitional effect on economic growth. This effect would be evident only when the dependent and working-age populations grow at different rates.

2.3 Overview of Literature

The reviewed literature shows that most previous studies have considered demographic change as a major determinant of overall economic growth. The studies have also given significant attention to the effect of demographic change on savings. However, they hardly narrowed down to industry/sector specific analysis of the impact population change. This implies that from past literature, it is difficult to establish how various sectors of the economy (and specifically manufacturing) have been affected by demographic transition. In a nutshell, it's not possible to tell whether manufacturing sector has realized any demographic dividend. In addition, most

of the empirical literature on demographic transition relates to Asian and Latin American economies. There are too few studies on the impact of demographic change on economies of COMESA Member States and the manufacturing sector. This leaves a research gap which the study attempts to fill by establishing the effects of demographic transition on manufacturing sector within the region.

3.0 Methodology

3.1 Theoretical Model

Following Thuku, Gachanja and Almadi (2013), this study adopted the Solow-Swan growth model to establish the relationship between share of working age population and manufacturing value added. The study extends the model by introducing the working age population and females' share of working age population in place of growth in total population and replacing the total output with output from manufacturing sector alone (manufacturing value added). This has been supported by Fakih and Ghazalian (2013) among others.

The model assumes that the rate of saving, population growth and technical progress are exogenously determined. Adopting the Solow-Swan growth model, an economy is assumed to produce at a given time according to Cobb-Douglas production function given by:

$$Y_t = AK_t^{\alpha} L_t^{1-\alpha} \qquad (1)$$

Where Y is total output, K is total capital, L is the size of the labour input and A is the level of technology.

The production function exhibits positive and diminishing marginal productivity with respect to capital and labour as well as constant returns to scale. The economy is assumed to be a one-sector economy, where output can be either be consumed or invested and capital depreciates at a constant positive rate (δ). Similarly, it is assumed that the labour force equals the working age population (N). Therefore, equation 1 above is re-written as follows:

$$Y_t = AK_t^{\alpha} N_t^{1-\alpha} \qquad (2)$$

The working age population and technology grow at constant rates expressed as follows:

$$N_t = nN_t \qquad (3)$$

$$\dot{A}_t = gA_t \qquad (4)$$

Where the dot over the variable denotes the derivative of the variable with respect to time, n and g are exogenous parameters.

According to Thuku, Gachanja, & Almadi (2013), the growth rate of a variable equals the rate of change of its logarithm form. Therefore, taking the logs of equations 3 and 4 gives:

$$LnN_t = \{LnN(0)\} + n_t \qquad (5)$$

$$LnA_t = \{LnA(0)\} + g_t \qquad (6)$$

Where N(0)and A(0) are the values of N and A at time zero. Equations 5 and 6 implies that the growth rates N and A are constant and that they equal n and g respectively. Taking the exponentials of equations 5 and 6 on both sides gives:

$$N_t = N(0)e^{nt} \qquad (7)$$

$$A_t = A(0)e^{nt} \qquad (8)$$

Therefore, from equations 7 and 8, the number of effective units of working age population A_tN_t, grows at rate n+g.

Based on the assumption that output can be either consumed or invested and capital depreciates at a constant positive rate (δ), the capital accumulation is expressed as:

$$\dot{K} = I_t - \delta K_t \qquad (9)$$

Where I_t is investment, δ is the depreciation rate.

According to the Solow-Swan model, investment equals savings and savings is a fraction of the output. This implies that:

$$I_t = S_t \quad \text{and} \quad S_t = sY_t \qquad (10)$$

Substituting equation 10 to 9 we get:

$$K = sY_t - \delta K_t \qquad (11)$$

Expressing equation 11 in per capita terms gives:

$$\dot{k} = sY_t + (\delta + n + g)K_t = sk_t^{\alpha} + (\delta + n + g)k_t \qquad (12)$$

Equation 12 implies that k converges to a steady state value $\dot{k}_t$ defined by:

$$\dot{k} = [s/(n + g + \delta)]^{1/1-\alpha} \qquad (13)$$

The steady state capital labour ratio is related positively to the rate of saving and negatively to the rate of population growth. The Solow model estimates the impact of saving and population growth on real income. Substituting 13 into the production function (2) and taking logs we find the steady state income per capita is:

$$\ln\frac{Y_t}{L_t} = \ln A(0) + g_t + \frac{\alpha}{1-\alpha}\ln(s) - \frac{\alpha}{1-\alpha}\ln(n+g+\delta) \qquad (14)$$

The model predicts not only the signs but also the magnitudes of the coefficients on saving and population change given that factors are paid their marginal products.

3.2 Empirical Model and Estimation Technique

3.2.1 Empirical Model

To capture the effect of demographic transition on manufacturing value added, the study adopted the model developed by Thuku, Gachanja and Almadi (2013). The model takes the general form of equation 14. Relating the theoretical model to the study, an extract from equation 14 can be expressed as:

$$lnMANV = \beta_0 + \beta_1 lnWAP + \beta_2 lnSWAPF + \beta_3 lnGDPPC_{t-1} + \beta_4 lnGCF + \varepsilon \quad (15)$$

Where MANV is the manufacturing value added, WAP is working age population (age 15-64 years), SWAPF is share of female workers in labour force, GDPPC is the gross domestic product per capita, GCF is the gross capital formation while ε is the stochastic error term.

Equation 15 was estimated using the ordinary least square method to achieve the study objectives.

3.2.2 Definition and Measurement of Variables

Manufacturing value added (MANV) refers to the net output of the manufacturing sector after adding up all output and subtracting intermediate output. It is measured at current prices (US dollars).

Working age population (WAP) refers all residents regardless of legal status or citizenship between the ages 15 to 64 years. It is the total labour force population that is, the number of people who could potentially be economically active. An increase in the working age population is expected to lead to an increase in both Manufacturing value added and Gross National Savings. Therefore, its coefficient is expected to be positive.

Female working age population (SWAPF) refers to share of females in labour force. An increase in the share of females in working age population leads to an increase in incomes of women and hence increase savings. It is also expected to lead to an increase in manufacturing value added and therefore, the coefficient is expected to be positive in both models that is in (17) and (18)

Gross domestic product per capita (GDPPC) refers to the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is measured at current prices (US dollars). An increase in GDP per capita is expected to lead to higher incomes and subsequently higher demand for manufactured goods. It is also expected to lead to higher savings implying that the coefficient is expected to be positive. The GDP is lagged by one period.

Gross capital formation (GCF) refers to the gross domestic fixed investment which includes

land improvements, plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. Data are in current U.S. dollars. Increase in capital is expected to lead to higher output from manufacturing. Therefore, its coefficient is expected to be positive.

3.2.2 Stationarity Test

Prior to estimation of the model, stationarity tests were done using the Augmented Dickey-Fuller (ADF) test, which takes into account the possibility of autocorrelation in the error term.

3.3 Data Type and Source

The study used annual secondary data for the period 1980 to 2017. The data for manufacturing value added, working age population (age 15-64 years), share of female workers in labour force, gross domestic product per capita and gross capital formation were obtained from African Development Bank Group (ADBG), World Bank and COMSTAT .

4.0 Estimation and Discussion of Results

4.1 Unit Root Test Results

The study adopted the ADF unit-root test to establish the presence of a unit root and the order of integration of the variables. The results of the unit-root test are presented in appendix 1. The findings indicate that manufacturing value added (MANV) was stationary at levels and integrated of order zero, I(0). The working age population (WAP), the share of females in labour force (SWAPF), gross domestic product per capita (GDPPC) and gross capital formation (GCF) were stationary at first difference and integrated of order one, I(1).

4.2 Effect of Working Age Population on Manufacturing Value Added

The regression results of the effect of working age population on manufacturing value added are shown in table 2.

Table 2: Effect of Working Age Population on Manufacturing Value Added

Dependent variable Manufacturing value added of COMESA as a bloc			
Independent variable	**Coefficient**	**Standard Error**	**P-value**
Working age population	1.7324*	0.0995	0.0032
Share of females in labour force	-2.9113*	1.2785	0.0298
Gross Domestic Product per Capita	0.0091	0.0522	0.8630
Gross capital formation	0.0481*	0.0176	0.0101
Overall R^2	0.8732		
F-statistic	2327.926	Probability	0.0000

The asterisk, * denote 1%, significance level

Source: Authors own computation from study data.

The results showed that all the coefficients of the variables had the expected signs. In addition, they all significantly explained the growth of manufacturing value added in COMESA region except the gross domestic product per capita. Over all, the model is significant given that 87 percent of the variations in the manufacturing value added is explained by the model.

The coefficient of the working age population was positive and significant at one percent level. This implies that working age population positively influences manufacturing value added. A one percent increase in the working age population increases the output of manufacturing sector by 1.7 percent in COMESA region. The findings are in line with Bloom et al. (2007) who found that an increase in the working age population increases production in various sectors of the economy, including the manufacturing sector. Similarly, gross capital formation positively affects the output in the manufacturing sector in COMESA region. The results indicated that a one percent increase in gross capital formation increased the output of the manufacturing sector by 0.05 percent.

The effect of female workforce on manufacturing value added was negative and significant. Specifically, a one percent growth in female workforce in the manufacturing sector reduced output by 2.9 percent. The results are consistent with works of Heshmati and Rashidghalam (2016) and Fakih and Ghazalian (2013) whose findings indicated that higher female share in the labour force reduced labour productivity and hence output in the manufacturing sector.

5.0 Conclusion and Policy Implications

5.1 Conclusion

The study analyzed the effects of demographic transition on manufacturing sector in COMESA region. It focused on the effect of working age population, gross domestic product per capita, share of females in working age population and gross capital formation on growth in value added in the manufacturing sector within COMESA. The study concludes that demographic transition impacts on the growth of manufacturing value added in the COMESA region. The working age population and gross capital formation positively influence the manufacturing sector value added. The share of females in the labour force had a negative effect on manufacturing sector value added. The paper concludes that the manufacturing sector within COMESA stands to benefit from the demographic transition that is currently taking place.

5.2 Policy implications

Based on the empirical results, this study recommends that COMESA Member States should develop and implement policies to increase the working age population in order to enhance performance in the manufacturing sector. The COMESA Secretariat and Member States should put in place policies to hasten demographic transition through increase in the working age population. Such policies include public programmes that encourage couples to reduce childbearing, the provision of affordable contraceptives to regulate fertility, improvement of health services sector and enhancement of reproductive health education.

Further COMESA Member States need to take deliberate measures to promote growth in capital formation. Such measures include collaboration between the government and the private sector

towards creating an enabling environment that promotes capital investment in the economy and encouraging commercial banks to reduce interest rates on loans and advances. Governments of Member States can directly contribute to capital formation by increasing spending on infrastructure such as roads, railways, schools, offices and hospitals.

There is also need for further research to establish the cause of the inverse relationship between the manufacturing value added and share of women in working age population. This will inform policy choices to reverse the situation rather than ruling out women participation in the labour force since such an action would be discriminatory. Furthermore, it is recommended that institutional framework variables be included as determinants for manufacturing value added. This would capture the effect of demographic change on the manufacturing sector within the COMESA region in a broader perspective. Lastly, the study recommends that country level analysis of the effect of demographic change on manufacturing sector be done to capture the specific dynamics of each of the COMESA Member States. This would address specific country concerns necessary to enhance manufacturing sector.

APPENDIX

Appendix 1: Unit Root Tests

Variables	Levels		First difference		Conclusion
	Constant, no trend	Constant, trend	Constant, no trend	Constant, trend	
LOG OF GROSS DOMESTIC PRODUCT PER CAPITA	-0.2813	-1.6318	-3.4023*	3.5507*	I(1)
LOG OF GROSS NATIONAL SAVINGS	-2.0568	-3.3855***	-6.8750*	-6.7058*	I(1)
LOG OF GROSS CAPITAL FORMATION	0.3042	-1.1337	- 4.4552*	- 4.5849*	I(1)
LOG OF MANUFACTURING VALUE ADDED	-0.0169	-3.4249***	-3.3067**	-6.2576*	I(0)
LOG OF SHARE OF FEMALES IN LABOUR FORCE	2.2289	-2.1543	-1.4979	-3.4778***	I(1)
LOG OF WORKING AGE POPULATION	-1.5174	-2.7387	-2.7995***	-3.0944	I(1)

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The Role of Fiscal Policy in Harnessing Demographic Dividend for Social-Economic Transformation in the Common Market for Eastern and Southern Africa

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The opinions expressed in this paper are those of the author and do not in any way represent those of Kenyatta University or UNECA.

Abstract

This study investigated the impact of fiscal policy on the indicators of socio-economic transformation (education, health outcomes, family planning and governance) among the COMESA Member States Using annual panel data for the period 2000 to 2016. The study estimated fixed effects, random effects, two-step GMM and ARDL models. The findings show that health outcomes depend positively on fiscal policy, private expenditure on health and negatively on the dependency ratio in the country. The level of education depends positively on fiscal policy, the economic environment in the countries and negatively on the dependency ratio and government control of corruption. Further, the study finds existence of a long run relationship between all the three indicators of governance and government expenditure on justice system. The study recommends that in the health sector, a public-private partnership framework should be put in place, more public resources channeled and efficiency in spending enhanced. There is need to focus on government provision of education and effectiveness of governance as an enabling environment in the education sector. Further, COMESA Member States should use fiscal policy to improve family planning and governance in the region by integrating family planning in the long-term development strategies.

Key Words: Fiscal Policy; Demographic Dividend; Government Expenditure; Education; Health; Family Planning; Governance.

1.0 Introduction

Countries cannot achieve sustainable development without ensuring that their populace enjoys dignity and human rights that can enhance their capabilities, secure their reproductive health, find decent jobs and contribute to economic growth and development. Formulating policies and creating environment that secure such socio-economic status require that the governments know the size, sex, location and age structure of the present and future population (UNFPA, 2017). Countries benefit from demographic dividend when they enter a period in which the working age population has good health, quality education, decent employment and lower proportions of young dependents. Additionally, smaller numbers of children per household generally lead to larger investment per child, more freedom for women to participate in formal employment and more savings per household for the old age.

> "The Demographic Dividend (DD) is a temporary opportunity for accelerated economic growth that is made possible by a sustained decline in birth and death rates, which leads to an increase in the ratio of working age population relative to young dependents. The size of the demographic dividend can be augmented if the resulting large working age population is well educated, skilled, healthy and economically engaged. This change in age structure can enhance economic productivity if the working age population and women, whose childrearing roles are reduced due to low fertility, have jobs. Further impetus for future economic growth is generated through increased savings and investments, which result from reduced costs of meeting the basic needs of dependent children." – (UNFPA, UN-Malawi & AFIDEP, 2016)[2].

However, for a country to realize such demographic dividend there must be multiple strategic investments including human resource development. Countries that implement comprehensive human development programmes stand to benefit from demographic dividend. This requires that young people get the chance to gain education and experience needed to succeed in a competitive global workplace. However, the realization of the demographic dividend is often derailed among many young people due to poor access to health care, limited education and other social and cultural factors. This leads to rise in the number of dependents and declined savings and investments among other effects.

United Nations (UN) and the African Union (AU) have initiated both global and continental agreements that are designed to shape the human development discourse as well as country specific policies. The UN 2030 Agenda goals 3, 4, and 8 on health, education and economic empowerment respectively, are aligned to the achievement of the human development indicators. The commitment of the 2030 agenda provides a framing tool to prioritize attention to human development dimensions and groups of people. The AU agenda 2063 aspires to have a prosperous Africa, based on inclusive growth and sustainable development that focuses on improving education, health, the standard of living and transformation of African economies.

According to AUC and UNECA (2013), there are five (5) Policy wheels for Harnessing the demographic dividend: accelerating demographic transition through investments that facilitate

2 The 2016 report UNFPA, UN MALAWI, African Institute for Development Policy (AFIDEP) and Ministry of Finance, Economic Planning and Development, pp 2.

rapid fertility decline; investing in high-level education to develop a well-educated, skilled and innovative labor force; provision of high-quality health services to nurture a healthy and productive labor force; enabling Economic reforms to accelerate economic growth, increase productivity, incentives for household savings, and job creation for the rapidly expanding labor force; and good governance and accountability measures to ensure the rule of law, efficiency in delivery of services, accountability in the use of public resources, investment in infrastructure, and attract foreign direct investment (FDI). All these are well linked (directly or indirectly) to various sustainable development goals.

Family planning is therefore an important tool in aligning demographic trends and development strategies. It is not only important in improving the health of women and children, but also in accelerating and sustaining national economic growth and fostering competitiveness in global economy (Husain, Patierno, Feranil, & Smith, 2016). More and more African countries are expanding healthy increases in modern contraceptive use. Between 2010 and 2015, the number of countries which experienced increased use of modern contraceptives increased from four (4) to ten (10). There is need to address the unmet need for family planning by reducing barriers to demand, access, and use, and increasing government investment in family planning. According to Singh & Darroch (2012), the use of modern contraceptive prevented 218 million unintended pregnancies in developing countries in 2012, and, in turn, averted 55 million unplanned births, 138 million abortions (of which 40 million are unsafe), 25 million miscarriages and 118,000 maternal deaths.

Governance is one of the main challenges that African continent is grappling with, yet is it also one of the issues of great significance to inclusive growth and sustainable development in the continent. Effective economic governance institutions are critical in the fight against corruption and also in the drive towards structural transformation and development in Africa (ECA, 2016). According to the Ibrahim Index of African Governance, only 2 out of 19 COMESA countries achieved progress in all the four components of the index. These included: Mauritius and Seychelles. Africa must conquer corruption and promote good leadership and governance. This requires all-inclusive development plans, policies and strengthened institutions and regulatory environments for supporting structural transformation, and promotion of dialogue on economic governance and public sector management.

It is envisaged that public spending on human development sectors like education and health, and government spending on justice system, can boost harnessing of demographic dividend in a country or region. However, there are different opinions about how public spending is affecting human development indicators in different economies. In the mid-1980s to late 1990s, the IMF analyzed the trends of government expenditures in countries with IMF-supported programs, that is, transition and developing economies. It was observed that increases in public spending on education and health in countries coincided with sizable improvements in education and health indicators. A number of indicators, including literacy levels, school enrolment, life expectancy and infant mortality rates, also improved. These increases were being accompanied by tangible improvements in social indicators and the benefits of social expenditure are distributed more fairly (Gupta, Clements, & Tiongson, 1998).

1.1 Population Structure in Africa

Africa's population was 1.2 billion in 2015 and is estimated to reach 1.7 billion in 2030, 2.5 billion in 2050 and 3 billion in 2063 (UN, 2017). Africa's share of the global population would have risen from 16 per cent in 2015 to about 30 per cent in 2063. By 2063, almost half (46 per cent) of the continent's increase in labor force will be the youth aged between 15 and 34, while 59 per cent will be under 30 years old by 2050, and 52 per cent by 2070 (Table1). This portrays a significant potential for social and economic transformation across the continent.

Table 1: Africa's Current and Projected Population by Age Groups (Millions)

AGE	2016	2050	2070
0 – 4	189 (**16%**)	280 (**11%**)	311 (**9%**)
4 – 14	308 (**25%**)	518 (**21%**)	597 (**8%**)
15 – 19	125 (**10%**)	235 (**9%**)	284 (**9%**)
20 – 29	207 (**17%**)	417 (**17%**)	532 (**16%**)
30+	387 (**31%**)	1,028 (**41%**)	1,598 (**48%**)
TOTAL	**1,216 (100%)**	**2,478 (100%)**	**3,322 (100%)**

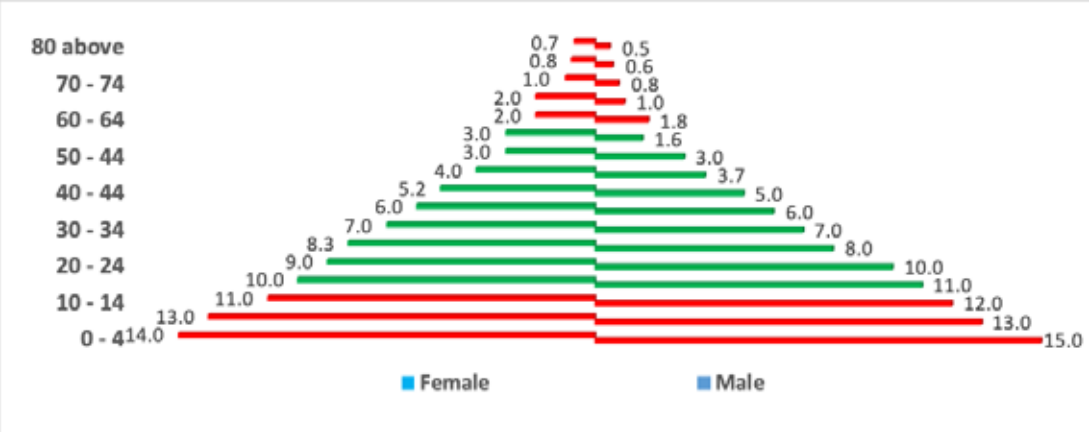
Source: UN Population Division, 2017.

Table 1 shows that majority of African population is aged below 30 years. This implies that young people in the continent can be critical agents for positive socioeconomic transformation if appropriate investments are made to enable them unleash their full potential to be productive and innovative. Lack of proper education, poor health and lack of socioeconomic investments in young people limit their ability to contribute to the socio-economic development of their nations. Many of them end up being development liability since they are uneducated, unskilled, unhealthy, without job opportunities, and can sometimes be agents of social unrest if they are without hope and disillusioned by the world economic and political order(Zulu, 2016). Between 1970s and 1990s, between 25 per cent to 33 per cent of East and South Asia economic growth was attributed to demographic dividend (DD) (Bloom and Williamson, 1998 and Mason, 2001). In China, data from World Bank indicate that structural advantage of DD has contributed to more than 30 per cent of the total economic growth (Monan, 2012). These resulted from sustained investments in education, health, family planning and economic reforms by the governments.

1.2 Demographic Dividend in COMESA

COMESA population age structure is presented in figure 1. The total population of the region stands at 534 million, and growth at an average of 2.21 per cent. Out of this, 38.1 per cent are in the age bracket 0 – 14; 58.0 per cent in age bracket of 15 – 64; while 4.0 per cent are 65 years or more (UNFPA, 2017 & WDI, 2018). This implies that 42 per cent of the population that is out of labor force.

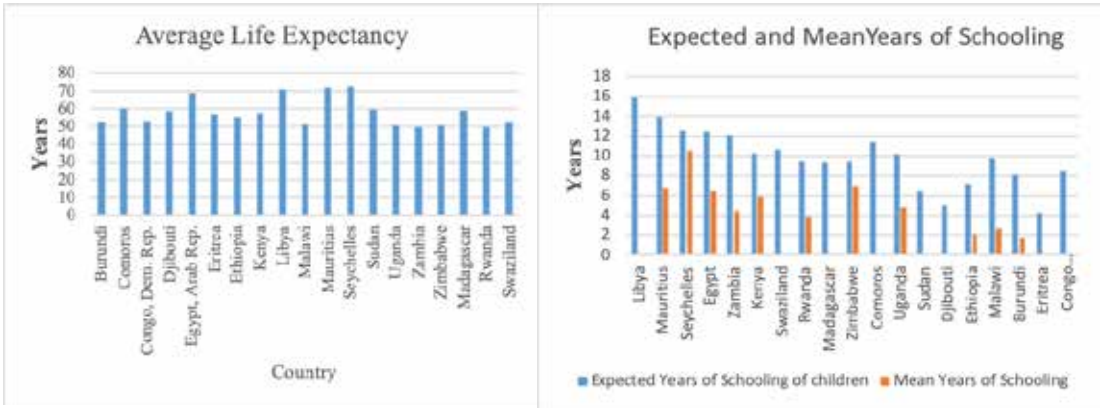
Figure 1 COMESA Population Age Structure



Source: World Development Indicators (WDI), 2018.

In COMESA the average life expectancy has been on the increase, from 53 years on average in the 1990 to 64 years in 2015. Seychelles has the highest life expectancy at about 72 years, while Zambia and Rwanda have the lowest at about 49 years. Similarly, education is a primary right for every individual and one of a major component of well-being. Education is an important variable for harnessing DD in a country. It is a key factor in determining a country's development level as literacy rates and productivity levels directly influence a country's prosperity and economic growth. In the human development index, education is measured on two levels: expected years of schooling for school-age children and average years of schooling in the adult population. Figure 1.2 summarizes the country specific value of indicators for health and education in COMESA for the period between 1990 and 2016. The mean years of schooling is way below the average expected years of schooling across all COMESA countries.

Figure 1.2: Average Life Expectancy, Expected Years Schooling for School-age Children and Average Years of Schooling in the Adult Population for COMESA (1990-2016)



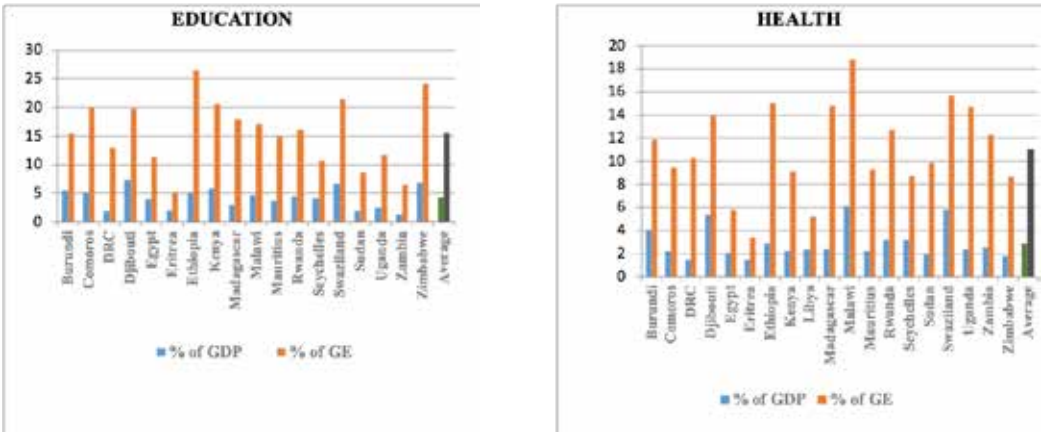
Source: Based on WDI & UNESCO data (2018)

1.3 Fiscal Policy in COMESA

Fiscal policy plays a key role in the economy by delivering on the three principal functions of government namely, efficient allocation of resources, fair distribution of incomes and stabilization of economic activity (Mumbi and Longa, 2015). An assessment of fiscal policy of COMESA countries on public expenditure since 1990s, provides insights on the changing role of the government in health, education and in promoting human development in the region. Government expenditure on education and health for many COMESA countries, averaged at 4.25 and 2.92 per cent of GDP respectively for the period 2005 - 2015.

As shown in Figure 1.3, the proportion of Member States budgets spent on health is on average 11 percent which is below the 15 per cent of the Abuja Declaration. While government expenditure on education as a share of total government expenditure averages at about 16 per cent in COMESA. **(see figure 1.3)**.

Figure 1.3: Government Expenditure on Education and Health as a percentage of the GDP and Total Government Expenditure (2005 – 2015).



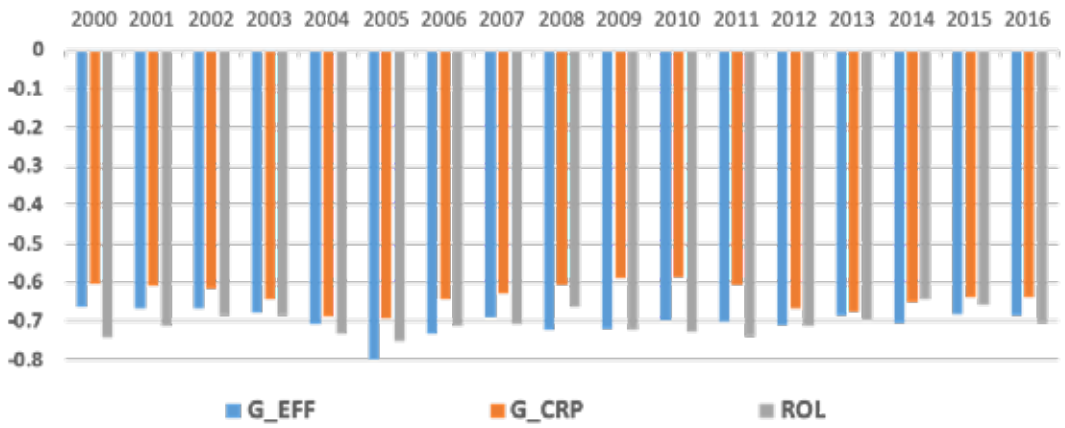
[3]Source: Based on WDI (2018)

1.4 Governance in COMESA

Governance is one of the main challenges that African continent is grappling with, yet it is also one of the issues of great significance to inclusive growth and sustainable development, and harnessing of demographic dividend in the continent. Effective economic governance institutions are critical in the fight against corruption and in the drive towards structural transformation and development in Africa (ECA, 2016). According to the Ibrahim Index of African Governance, only 2 out of 19 COMESA countries achieved progress in all the four components of the index. These included: Mauritius and Seychelles. Africa must conquer corruption and promote good leadership and governance. This requires all-inclusive development plans and policies, and strengthened institutions and regulatory environments for supporting structural transformation, and promotion of dialogue on economic governance and public sector management. Figure 1.4 shows the scores for various governance indicators in COMESA, that is: Government effectiveness (G_EFF); Government control of corruption (G_CRP); and the Rule of law (ROL).

3 Data on Libya is not available.

Figure 1.4: Governance Indicators: 2000 - 2016



Literature shows that rapid demographic change was a necessary condition for rapid economic growth in the East Asian countries. It created development opportunities, helped in reducing rates of childbearing and slowing population growth rates, and significant declines in fertility. It influenced the relative sizes of the dependent and working age populations, the economic roles of women, incentives for savings and investments, and spending on the health and education of children, among other things. The role of the governments in facilitating the availability of contraceptive technology, ensuring macroeconomic stability, and formulating policies that attached a high priority to education and health was significant (UNFPA, UN-Malawi & AFIDEP, 2016). The objective of this study therefore was empirically investigate the role of the government in harnessing demographic dividend in COMESA. Specifically, the study analyzed the impact of fiscal policy on education, health outcomes, family planning and governance among the COMESA countries.

2.0 Review of the Literature

Baldacci, Clements, Gupta, and Cui (2004) used panel data from 120 developing countries from 1975 to 2000 to explore the direct and indirect channels linking social spending, human capital, and growth in a system of equations. The study found that both education and health spending have a positive and significant direct impact on the accumulation of education and health capital, and a positive and significant indirect impact on growth. An increase in education spending of 1 percentage point of GDP is associated with 3 more years of schooling on average and a total increase in growth of 1.4 percentage points in 15 years. Similarly, an increase in health spending of 1 percentage point of GDP is associated with an increase of 0.6 percentage points in the under-5 child survival rate and a rise of 0.5 percentage point in annual per capita GDP growth. There is a significant time lag between increases in education spending and the realization of their full effects on social indicators and growth. Two-thirds of the direct impact of education spending is felt within five years, but the full impact materializes with a significant time lag of 10 to 15 years. Such a lag needs to be kept in mind when designing policy interventions. The impact of health spending, however, is immediate. The positive effects are the highest in low-income countries and sub-Saharan Africa.

Davies (2009) examined data belonging to 154 countries for the period 1975-2002 in order to analyse the relationship between government consumption spending and human development index. He found that government consumption spending effected the human development in a positive Manner, improved size was followed by improved per-capita income, then improved literacy and improved longevity, in that order.

Prasetyo & Pudjono, (2013) examined government expenditure efficiencies on human development among 82 countries in the years 2007 and 2011. Among countries studied 6 of them were COMESA Member States (Egypt, Ethiopia, Kenya, Madagascar, Uganda and Zambia). Only 23 countries were registered to have made positive improvements of the government expenditure efficiencies, and all the COMESA countries obtained negative efficiency as the increase in their government expenditures were not balanced with the increase in HDI score.

Building a panel-data-set of ten Arab countries, spanning the time between 1990 and 2015, Sarangi & Bonin (2017) assessed whether public social spending has direct and positive impact on growth, education and health. Impact multipliers of social expenditure on growth, and impact coefficients of health and education expenditure on respective achievements were estimated. A dynamic panel-estimation is modeled separately for health and education impact coefficients, using least square dummy variable bias corrected (LSDVC) fixed effects, and a two-step generalized method of moments (2S-GMM). The empirical results showed that public education spending does have a positive and significant impact on education achievements, and the impact is stronger for the oil-poor countries than that of the oil-rich countries. Public health spending has an insignificant impact on health outcomes but that is due to the fact that out-of-pocket expenditure has a strong positive impact on health outcomes. Negligence of public investment in health has severe implications for the poor and middle class of the region, particularly when the region is experiencing rising poverty and high stunting. The long-term impact coefficient of public spending on education on achieving mean years of schooling suggested that that by increasing public education spending by 1 percent of GDP, the region can catch up with average years of education at global level within 6 years.

3.0 Methodology

3.1 Theoretical Framework

This study is based on the Keynesian Theory of Public Expenditure and the Wagner's Organic State Theory. According to Keynes (1936), the government is responsible for helping to pull a country out of distress, and to avoid crisis - (failure of laissez-faire economics). Public expenditure is a fundamental determinant of economic growth and development. Keynes argues that government expenditure, as a fiscal policy instrument, is useful for achieving short-term stability and higher long run growth rate. The theory therefore prescribes for government interventions in the economy through the fiscal policies as this plays a crucial role in the development process. Wagner (1883 & 1890) argues that the state grows like an organism reflecting changes in society and economy. It implies that development of the economy must be accompanied by an increase in share of the public expenditure in the GDP. The government must be ready to spend to deal

with issues such as: administration, law and order; increasing concern for distribution of income and wealth; and the greater need to correct market failures, among others.

3.2 Model Specification

For health and education, dynamic panel models were specified and estimated using the fixed effects, random effects and two-step GMM approaches. For family planning and governance, bivariate autoregressive distributed lag (ARDL) models were specified and estimated in a panel set up. Conceptually, the level and/or effectiveness of education, health, family planning and governance attained in the country at any given time is influenced also by the accumulation of the same over time as well as the current levels. Given the dynamic nature of the indicators of education and health (they grow over time, generally), the study adopted a dynamic panel model for each of the variables. The model takes the following form:

$$Y_{it} = \phi + \alpha Y_{it-1} + \beta X_{it} + \upsilon_i + \varepsilon_{it} \quad \ldots\ldots 1$$

Where:

Y – Dependent variable (education/health/family planning/governance)
X – Vector of independent variables including relevant components of government expenditure (both endogenous and exogenous regressors)
υ - Unobserved time-invariant country-specific effect.
ε - Observed error term.

For each of the dependent variables, the following models were specified:

i. Education Model

$$EDU_{it} = \alpha_1 + \alpha_2 EDU_{it-1} + \beta_1 G\_EDU_{it} + \beta_2 P\_EDU_{it} + \beta_3 G\_SS_{it} + \beta_4 GDPPC_{it} + \beta_5 G\_EFF_{it} + \beta_6 G\_CRP_{it} + \upsilon_i + \varepsilon_{it} \quad \ldots\ldots 2$$

Where:

EDU – Mean of years of schooling

G_EDU – Government expenditure on education as share of GDP

P_EDU – Private expenditure on education as share of GDP

G_SS – Government expenditure on social sector as share of GDP

GDPPC – GDP per capita

G_EFF – Government effectiveness index[4]

G_CRP – Government corruption control index[5]

4 Government effectiveness reflects the perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.
5 Government control of corruption reflects perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests.

iii. **Health Model**

$$HLT_{it} = \alpha_1 + \alpha_2 HLT_{it-1} + \beta_1 G\_HLT_{it} + \beta_2 P\_HLT_{it} + \beta_3 G\_SS_{it} + \beta_4 GDPPC_{it} + \beta_5 G\_EFF_{it} + \beta_6 G\_CRP_{it} + DR_{it} + \upsilon_i + \varepsilon_{it} \quad \text{......3}$$

Where:

HLT – Life expectancy years

G_HLT – Government expenditure on health as share of GDP

P_HLT – Private expenditure on health as share of GDP

G_SS – Government expenditure on social sector as share of GDP

GDPPC – GDP per capita

G_EFF – Government effectiveness index

G_CRP – Government corruption control index

DR – Dependency ratio

For family planning and governance, bivariate autoregressive distributed lags (ARDL) models were specified. The beauty of the ARDL model is that is can be used to evaluate both short run and long run relationships between variables even when there is lack of theoretical linkage between the variables. For Panel data analysis, ARDL also enables the analysis of the relationships per individual country. It is conceptually expected that higher government expenditure on reproductive health leads to higher uptake and utilization of family planning among women of birth-giving aged (assumed to be 15 – 49 in this study). Similarly, government expenditure on justice system should lead to improvement in governance in the in the country. Governance is used as a proxy for favourable economic environment that enables the labour force to acquire to be engaged in productive and income generating activities. Three indices of governances (government effectiveness, government control of corruption and rule of law) are used in these models.

ARDL model aids analysis where variables are linked to their own past values and the current and past values of the variable(s) in the model, since it describes the dynamic evolution of a number of variables from their common history. The models for family planning and governance therefore take the form:

iii. **Family planning model**

$$\Delta FP_{it} = \phi_{it} + \sum_{j=1}^{k} \alpha_j \Delta FP_{it-j} + \sum_{j=0}^{k} \beta_j \Delta G\_REPHLT_{it-j} + \beta_1 FP_{it-1} + \beta_2 G\_REPHLT_{it-1} + \varepsilon_{it} \quad \text{.........(4)}$$

Where:

FP – Contraceptive use (all methods) among the married women aged 15 – 49 as a share of all married women.

G_REPHLT – Government expenditure on reproductive health as share of GDP

iv. **Governance models**

Three indicators of governance (government effectiveness, government control of corruption and rule of law) are regressed against government expenditure in the justice system. Three bi-variate ARDL models are specified as follows:

$$\Delta G\_EFF_{it} = \phi_{it} + \sum_{j=1}^{k} \alpha_j \Delta G\_EFF_{it-j} + \sum_{j=0}^{k} \beta_j \Delta G\_JS_{it-j} + \beta_1 G\_EFF_{it-1} + \beta_2 G\_JS_{it-1} + \varepsilon_{it} \ldots\ldots\ldots(5)$$

$$\Delta G\_CRP_{it} = \phi_{it} + \sum_{j=1}^{k} \alpha_j \Delta G\_CRP_{it-j} + \sum_{j=0}^{k} \beta_j \Delta G\_JS_{it-j} + \beta_1 G\_CRP_{it-1} + \beta_2 G\_JS_{it-1} + \varepsilon_{it} \ldots\ldots\ldots(6)$$

$$\Delta ROL_{it} = \phi_{it} + \sum_{j=1}^{k} \alpha_j \Delta ROL_{it-j} + \sum_{j=0}^{k} \beta_j \Delta G\_JS_{it-j} + \beta_1 G\_ROL_{it-1} + \beta_2 G\_JS_{it-1} + \varepsilon_{it} \ldots\ldots\ldots(7)$$

Where:

G_EFF – Government effectiveness index
G_CRP – Government corruption control index
ROL – Rule of law index[6]
G_JS – Government expenditure on justice system

3.3 Data Type and Sources

The study used data for the period 2000 – 2016. Data on government expenditure on education, health, social sector, justice system and reproductive health were obtained from World Bank's World Development Indicators (WDI) and National Economic Surveys (various Issues). Data on the achievements in health, family planning and education outcomes were sourced from the UNDP's Human Development Reports database, while data on governance indicators were obtained from the World Bank's Worldwide Governance Indicators database.

Estimation and Discussion of Results

4.1 Diagnostic Tests

To determine the appropriate models and estimation procedures, several diagnostic tests, including unit root tests, Hausman test, test for heteroskedasticity and test for multi-collinearity were carried out. The panel root test developed by Im, Pesaran & Shin (1997; 2003) was performed and results presented in Table 4.1.

Table 4.1: Panel Root Test Results

Variable	Levels		First Difference	
	t-Statistic	P-Value	t-Statistic	P-Value
Government Effectiveness	-1.3535	0.6173	-4.7518***	0.0000
Government Control of Corruption	-1.7990	0.2218	-3.4318***	0.0001
Education	-0.6882	0.9837	-3.6826***	0.0000
GDP Per Capita	-0.4479	0.9989	-3.7590***	0.0000

6 Rule of law reflects perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.

Dependency Ratio	-1.6852	0.9005	-2.9103***	0.0018
Health	-2.3319	0.1309	-4.5651***	0.0000
Govt. Expenditure on Education	-1.6527	0.1379	-4.2814***	0.0000
Govt. Expenditure on Health	-1.3690	0.6657	-4.0278***	0.0000
Private Expenditure on Health	-1.0644	0.9825	-8.0683***	0.0000
Family Planning	-1.0093	0.9926	-3.5542***	0.0000
Govt. Exp. on Reproductive Health	-1.6706	0.2180	-3.7657***	0.0000
Rule of Law	-1.5298	0.5592	-3.3809***	0.0000
Govt. Exp. on Judicial System	-1.5647	0.2253	-3.4277***	0.0000

The panel root results show that all variables were non-stationary at levels but become stationary upon first differencing. The Hausman test results for all the models are presented in Table 4.2.

Table 4.2: Hausman Test Results – All Models

	Health Model	Education	Family Planning	Governance
$Chi^2(.)$	102.62	58.35	0.02	1.09
$Prob>chi^2$	0.000	0.3401	0.0101	0.2967

Based on the Hausman test results, the appropriate estimation technique was employed for each of the models.

4.3 Health and Education Models

To help in determining which between random effects (RE) model and fixed effects (FE) model is the most appropriate for the study data, Hausman test was carried out. Hausman (1978) suggested a test for correlation between the unobserved effect (the country-specific effect) and the explanatory variables as comparison between the fixed effect and random effect estimates, assuming that the idiosyncratic errors and explanatory variables are uncorrelated across all time periods. The Hausman test results (Table 4.2) show rejection of the null hypothesis of "no systematic difference in random and fixed effects coefficients" for the health model, and failure to reject the null hypothesis for the education model. This implied that the RE specification was most suitable for the health model, while FE specification was appropriate for the education model. The results for multi-collinearity and heteroscedasticity tests are presented in Tables 4.3 and 4.4 respectively.

Table 4.3: Test for Multi-collinearity – Health and Education Models

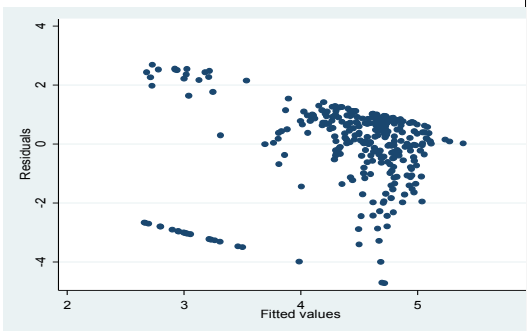
Health Model			Education Model		
Variable	**VIF**	**1/VIF**		**VIF**	**1/VIF**
Government Expenditure on Health	1.35	0.740	**GDP Per Capita**	4.01	0.249
Private Expenditure on Health	1.40	0.714	**Dependency Ratio**	4.39	0.228

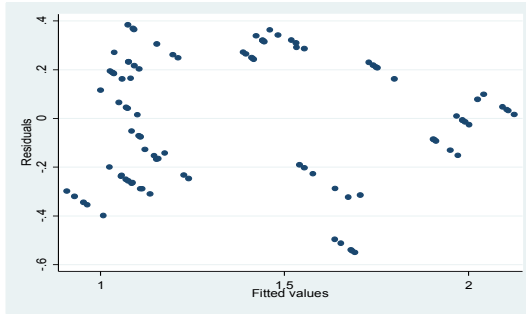
GDP Per Capita	1.27	0.785	**Government Control of Corruption**	2.21	0.452
Government Effectiveness	2.97	0.337	**Government Expenditure on Education**	1.18	0.844
Government Control of Corruption	2.89	0.345	**Government Effectiveness**	2.94	0.340
Dependency Ratio	1.47	0.681			
Mean VIF	1.85		**Mean VIF**	2.95	

In the presence of multicollinearity, the estimate of one independent variables' impact on the dependent variable, while controlling for the other independent variables, tends to be less precise than if the predictors were uncorrelated with one another. Additionally, multicollinearity tends to make the standard errors of the affected coefficients larger, which may lead to failure to reject a false null hypothesis. According to Gujarati (2003), any variable with variance inflation factor (VIF) of more than 5 is highly correlated with other exogenous variables and must therefore be dropped from the model. The results show that all variables have VIF values bellow 5, hence no multicollinearity problem in the data sets. The mean VIF for the health model and education model are 1.85 and 2.95 respectively.

Table 4.4: Test for Heteroskedasticity – Health and Education Models

H0: Constant Variance			
Health Model		**Education Model**	
$Chi^2(1)$	135.03	$Chi^2(1)$	0.27
$Prob>Chi^2$	0.0000	$Prob>Chi^2$	0.6018





In the presence of heteroskedasticity, confidence intervals and hypotheses tests are not reliable. Breusch-Pagan/Cook-Weisberg test for heteroskedasticity was performed. It tests the null hypothesis that the error variances are all equal versus the alternative that the error variances are a multiplicative function of one or more variables (Breusch & Pagan, 1979 and Cook & Weisberg, 1983). The results presented in Table 4.4 indicate the failure to reject the null hypothesis of constant variance for education model, and rejection of the null hypothesis for health model. This implies that the data set for education model is homoscedastic, while data set for health model is heteroskedastic. To eliminate the problem of heteroscedasticity, the study employed the two-step GMM estimation procedure. GMM techniques also eliminates the problem of serial

correlation and endogeneity that could be present in the data sets.

Table 4.5: Estimation Results for Health Model: GMM and RE Models

VARIABLE	GMM MODEL (Dependent variable = Health)	RE MODEL (Dependent variable = Health)
Health $_{t-1}$	0.7868*** [0.0449]	0.7868*** [0.0604]
Govt. Exp. on Health	0.1110** [0.4170]	0.1110** [0.5554]
Private Exp. on Health	0.0887* [0.0424]	0.0887 [0.0643]
GDP per Capita	1.0442 [2.8907]	1.0442 [3.89.3]
Dependency Ratio	-0.0364* [0.0220]	-0.0364 [0.0670]
Government Effectiveness	0.0205 [9.1546]	0.0205 [8.4179]
Govt. Control of Corruption	8.9448 [9.8820]	8.9448 [12.8063]
Constant	-19.7097 [30.1485]	-19.7097 [28.7951]
	No. of observation = 322 No. of parameters = 8 No. of instruments = 8 GMM weight matrix = Robust Instruments: hlt; ghlt; phlt; gdppc; dr; geff; gcrp _cons	No. of observation = 322 R-sq. – within = 0.2908 between = 0.9608 overall = 0.6133 Wald chi2(7) = 497.98 Prob > chi2 = 0.0000

1. ***,** and * represent the level of significance at 1, 5 and 10 per cent respectively.
2. Values in [ ] represent the standard errors.
3. Government expenditure on social sector is excluded due to lack of data.

The coefficients of all variables in the health model have the right expected signs. However, some variables (GPD per capita, Government effectiveness and Government control of corruption) are found to be statistically insignificant at all levels of significance. These results indicate that the state of health of the populace in COMESA countries depend positively of fiscal policy (Government expenditure on health), the previous year state of health in the country, private expenditure on health and negatively on the dependency ratio in the country.

Table 4.6: Estimation Results for Education Model: GMM and FE Models

VARIABLE	GMM MODEL (Dependent variable = Education)	FE MODEL (Dependent variable = Education)
Education $_{t-1}$	0.3876** [0.1828]	0.2938*** [0.0565]
Govt. Exp. on Education	0.0071* [0.0030]	0.0041 [0.0027]
GDP per Capita	0.6660*** [0.2248]	2.1102*** [0.7490]
Dependency Ratio	-0.0080** [0.0040]	-0.0526*** [0.0190]
Government Effectiveness	1.6497*** [0.6060]	0.4919 [0.4569]
Govt. Control of Corruption	-1.4904*** [0.4762]	-0.5384 [0.3659]
Constant	-2.4042 [1.7088]	-7.0203 [5.4188]
	No. of observation = 96 No. of parameters = 7 No. of instruments = 7 GMM weight matrix = Robust Instruments: edu; gedu; gdppc; dr; geff; gcrp _cons	No. of observation = 96 R-sq. – within = 0.6985 between = 0.8280 overall = 0.7493 F (6,83) = 497.98 Prob >F = 0.0000

1. ***,** and * represent the level of significance at 1, 5 and 10 per cent respectively.

2. Values in [ ] represent the standard errors.

3. Government expenditure on social sector and private expenditure on education are excluded due to lack of data

In the education model, the coefficients of all variables (except government control of corruption) have the expected right signs, and all the coefficients are statistically significant at different levels of significance. The results indicate that the level of education of the populace in COMESA countries depend positively of fiscal policy (government expenditure on education), the previous year level of education in the country, the economic environment in the countries (government effectiveness) and negatively on the dependency ratio and government control of corruption in the country.

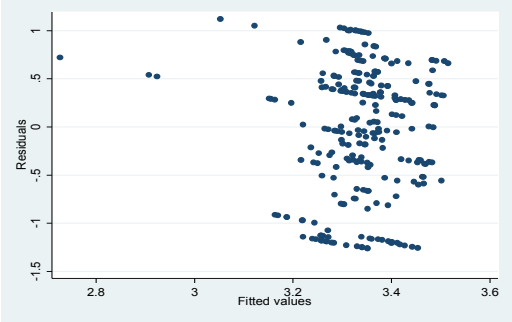
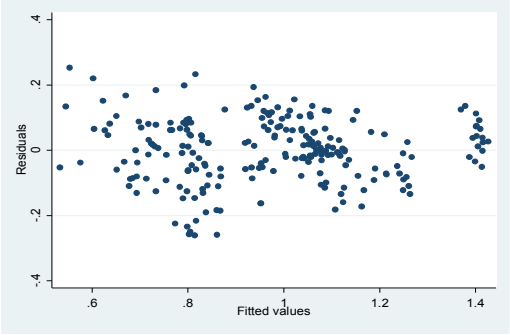
4.2 Family Planning and Governance Models

To estimate the short run and long run relationships between family planning and government expenditure on reproductive health[7]; and the relationship between governance and government expenditure on justice system, several ARDL models were estimated. The preconditions for running a panel ARDL model must be met before estimation. To determine which model to estimate between the pooled mean group (PMG) model (restricted ARDL estimation) and the

7 Due to lack of data on government expenditure on reproductive health among the COMESA countries, the study used the figures for public expenditure on health, as a percentage of GDP.

mean group (MG) model (unrestricted ARDL estimation), the hausman test was carried out (Table 4.2) and MG was selected for family planning model, and PMG selected for governance model.

Table 4.7: Test for Heteroskedasticity – Health and Education Models

H0: Constant Variance			
Family Planning Model		**Governance Model**	
$Chi^2(1)$	4.10	$Chi^2(1)$	12.72
$Prob>Chi^2$	0.0000	$Prob>Chi^2$	0.6018
			

The results indicate the failure to reject the null hypothesis of constant variance for both family planning and governance models. This implies that the data set for the models is homoscedastic.

Table 4.8: Pooled Results for Family Planning Model: ARDL Model

Variable	**LONG RUN (Dependent Variable = Family Planning)**		**SHORT RUN (Dependent Variable = Family Planning)**	
	Coefficient	**P-Value**	**Coefficient**	**P-Value**
Government Expenditure on Health	**7.39767**	**0.090**	**-0.6009**	**0.294**
ECT	-	-	**-0.30541**	**0.000**
Constant	-	-	**9.94813**	**0.048**

The regression results show that there exists a weak long run relationship (at 10 per cent level of significance) between family planning and government expenditure on health among the COMESA Member States. Pooled results however show no significant short run relationship between the variables. These may however vary for each of the countries in the panel.

To identify the possible variations, we decompose both the short run and long run relationships per individual country. The results for short run and long run relationships per country are presented in Table 4.9

Table 4.9: Country-wise Results the Family Planning Model: ARDL Model

Country	Variable	LONG RUN (Dependent Variable = Family Planning)		SHORT RUN (Dependent Variable = Family Planning)	
Burundi		**Coefficient**	**P-Value**	**Coefficient**	**P-Value**
	Government Expenditure on Health	4.04725	0.515	2.26051	0.169
	ECT	-	-	-0.19685	0.089
	Constant	-	-	0.44169	0.092
Comoros					
	Government Expenditure on Health	-11.4687	0.906	-1.22911	0.201
	ECT	-	-	-0.02540	0.904
	Constant	-	-	0.84371	0.886
DRC					
	Government Expenditure on Health	-8.4082	0.016	2.54122	0.195
	ECT	-	-	-0.38443	0.065
	Constant	-	-	12.30631	0.093
Djibouti					
	Government Expenditure on Health	7.0890	0.000	-4.27171	0.012
	ECT	-	-	-0.56241	.0002
	Constant	-	-	9.59672	0.051
Egypt					
	Government Expenditure on Health	-8.89925	0.000	1.55732	0.579
	ECT	-	-	-0.95222	0.004
	Constant	-	-	74.1397	0.007
Eritrea					
	Government Expenditure on Health	-0.4666	0.834	0.04406	0.797
	ECT	-	-	-0.10614	0.052

	Constant	-	-	1.96101	0.057
Ethiopia					
	Government Expenditure on Health	27.66748	0.041	-5.09698	0.107
	ECT	-	-	-0.27354	0.017
	Constant	-	-	4.64513	0.022
Kenya					
	Government Expenditure on Health	63.32021	0.936	-1.44719	0.647
	ECT	-	-	-0.03905	0.093
	Constant	-	-	2.21452	0.095
Libya					
	Government Expenditure on Health	3.5338	0.612	-0.35646	0.554
	ECT	-	-	-0.11667	0.068
	Constant	-	-	3.90122	0.076
Madagascar					
	Government Expenditure on Health	-0.28090	0.845	1.91038	0.611
	ECT	-	-	-0.31032	0.025
	Constant	-	-	14.54677	0.282
Malawi					
	Government Expenditure on Health	22.29634	0.871	-0.28085	0.855
	ECT	-	-	-0.03817	0.088
	Constant	-	-	1.10762	0.084
Mauritius					
	Government Expenditure on Health	0.25100	0.733	0.10677	0.804
	ECT	-	-	-0.50593	0.005
	Constant	-	-	38.06585	0.004
Rwanda					
	Government Expenditure on Health	-0.12939	0.998	-1.66263	0.543

	ECT	-	-	-0.048463	0.071
	Constant	-	-	4.28281	0.071
Sudan					
	Government Expenditure on Health	2.06906	0.279	-0.97682	0.144
	ECT	-	-	-0.272911	0.089
	Constant	-	-	2.03440	0.073
Eswatini					
	Government Expenditure on Health	8.21107	0.000	-2.92063	0.407
	ECT	-	-	-0.57301	0.072
	Constant	-	-	6.92774	0.204
Uganda					
	Government Expenditure on Health	33.40303	0.145	-4.54511	0.000
	ECT	-	-	-0.19196	0.091
	Constant	-	-	9.553354	0.044
Zambia					
	Government Expenditure on Health	-5.68276	0.020	2.75806	0.076
	ECT	-	-	-0.36517	0.030
	Constant	-	-	23.00561	0.028
Zimbabwe					
	Government Expenditure on Health	-0.86612	0.577	0.792790	0.498
	ECT	-	-	-0.53453	0.076
	Constant	-	-	34.72796	0.072

The breakdown of the short run and long run relationships shows mixed results across the countries. Generally, most of the countries in the panel (16 out of 18) do not show any significant short run relationship between family planning and government expenditure on health. Similarly, 12 out of 18 countries show no significant long run relationship between family planning and government expenditure on health. The results reveal a short run relationship between family planning and government expenditure on health only in Djibouti and Zambia. While long run relationship between family planning and government expenditure on health is evident only in DRC, Djibouti, Egypt, Ethiopia, Eswatini and Zambia.

Table 4.10: Estimation Results for Governance Model: ARDL Model

Variable	Government Effectiveness		Govt. control of Corruption		Rule of Law	
LONGRUN						
	Coefficient	**P-Value**	**Coefficient**	**P-Value**	**Coefficient**	**P-Value**
Government Expenditure on Justice System	-0.00056	0.000	-0.00017	0.015	0.0015	0.000
SHORT-RUN						
	Coefficient	**P-Value**	**Coefficient**	**P-Value**	**Coefficient**	**P-Value**
Government Expenditure on Justice System	-0.00016	0.988	-0.0026	0.377	0.00014	0.819
ECT	-0.2727	0.000	-0.3469	0.000	-0.3222	0.000
Constant	0.7602	0.000	0.9675	0.000	1.2590	0.000
Log likelihood	184.06		253.2958		236.8498	

The regression results show that there exists a long run relationship between all the three indicators of governance and government expenditure on justice system among the COMESA Member States. The hypothesis of possibility of short run relationship is however rejected for the panel at all levels of significance. This may however vary for each of the countries in the panel. To identify the possible variations, we decompose the short run relationship per individual country. The results for short run relationship per country are presented in Table 4.11.

Table 4.11: Short-run Results the Governance Model Country-wise: ARDL Model

		Government Effectiveness		Govt. control of Corruption		Rule of Law	
Country	**Variable**	**Coefficient**	**P-Value**	**Coefficient**	**P-Value**	**Coefficient**	**P-Value**
Burundi	Government Expenditure on Justice System	-0.00047	0.897	-0.0001	0.971	0.00185	0.648
	ECT	-0.4635	0.028	-0.1725	0.025	-0.5484	0.023
	Constant	1.0695	0.029	0.3947	0.046	2.05197	0.024

Comoros	Government Expenditure on Justice System	-0.0021	0.971	-0.0402	0.053	-0.0055	0.859
	ECT	-0.2170	0.017	-0.3651	0.003	-0.77860	0.000
	Constant	0.4105	0.038	1.02276	0.002	2.2949	0.000
DRC	Government Expenditure on Justice System	0.00062	0.251	0.00023	0.672	-0.0003	0.958
	ECT	-0.4245	0.004	-0.6307	0.004	-0.73333	0.001
	Constant	0.8466	0.004	1.3649	0.004	2.2949	0.001
Egypt	Government Expenditure on Justice System	-0.00004	0.727	0.00001	0.919	-0.00006	0.611
	ECT	-0.1754	0.020	-0.7077	0.002	0.0199	0.064
	Constant	0.7509	0.021	2.3319	0.002	0.42260	0.056
Eritrea	Government Expenditure on Justice System	0.00246	0.407	0.00014	0.916	0.00164	0.306
	ECT	-0.1279	0.049	-0.2998	0.000	-0.06861	0.031
	Constant	0.2754	0.051	0.8792	0.000	0.2007	0.042
Kenya	Government Expenditure on Justice System	-0.00021	0.527	0.0004	0.181	0.00027	0.563
	ECT	-0.0623	0.089	-0.9863	0.000	-0.17453	0.049
	Constant	0.2282	0.085	2.5817	0.000	0.60831	0.048
Madagas-car	Government Expenditure on Justice System	0.00427	0.018	0.00178	0.278	0.00311	0.025
	ECT	-0.1028	0.025	0.00483	0.063	-0.14366	0.079
	Constant	0.24700	0.029	0.4486	0.089	0.58819	0.097
Malawi	Government Expenditure on Justice System	0.00102	0.590	0.00341	0.013	0.00272	0.033
	ECT	-0.23938	0.060	-0.3737	0.001	-0.44317	0.038
	Constant	0.6991	0.064	1.08727	0.001	2.06632	0.039

Mauritius							
	Government Expenditure on Justice System	0.00073	0.686	-0.00117	0.336	0.00184	0.054
	ECT	-0.1384	0.095	-0.31500	0.096	-0.28797	0.022
	Constant	0.6294	0.093	1.23363	0.096	1.6399	0.025
Rwanda	Government Expenditure on Justice System	-0.00078	0.875	0.00281	0.411	0.00111	0.627
	ECT	-0.1630	0.061	-0.03141	0.071	-0.0714	0.031
	Constant	0.57477	0.063	0.17855	0.065	0.3845	0.024
Sudan	Government Expenditure on Justice System	0.00013	0.553	-0.00014	0.634	-0.00012	0.643
	ECT	-0.6914	0.002	-0.32812	0.010	-0.17096	0.088
	Constant	1.7741	0.001	0.73217	0.020	0.46916	0.073
Eswatini	Government Expenditure on Justice System	-0.0067	0.018	-0.00373	0.044	-0.00323	0.145
	ECT	-0.31867	0.052	-0.34994	0.037	-0.16678	0.026
	Constant	0.9408	0.046	1.11169	0.038	0.73972	0.021
Uganda	Government Expenditure on Justice System	0.00076	0.041	0.00047	0.053	-0.00049	0.357
	ECT	-0.7465	0.000	-0.05761	0.086	-0.47246	0.014
	Constant	2.3090	0.000	0.13674	0.067	2.04014	0.013
Zimbabwe	Government Expenditure on Justice System	0.00029	0.602	-0.00012	0.054	-0.00109	0.000
	ECT	-0.05314	0.096	-0.2435	0.049	-.470217	0.000
	Constant	0.11213	0.088	0.53416	0.044	1.47163	0.000

The breakdown of the short run relationships shows mixed results across the countries and across different indicators of governance. Generally, most of the countries in the panel (about 70 per cent) do not show any significant short run relationship between governance and government expenditure on justice system. The results however reveal a short run relationship between government effectiveness and government expenditure on justice system in Madagascar, Eswatini and Uganda. For government control of corruption and expenditure on justice system, the results show significant short run relationship in Comoros, Malawi, Eswatini, Uganda

and Zimbabwe. While the same significant short run relationship between the rule of law and expenditure on justice system is revealed in Madagascar, Malawi, Mauritius and Zimbabwe.

5.0 Conclusion and Policy Implications

This study investigated the impact of fiscal policy on the indicators of socio-economic transformation (education, health outcomes, family planning and governance) among COMESA Member States using annual panel data for 2000 to 2016. The study used the fixed effects, random effects and GMM estimation techniques. The study found that fiscal policy has significant role in harnessing demographic dividend within the COMESA region, both in the short run and in the long run. The magnitude of the effect of fiscal policy however varies across the Member States.

The study findings have several policy implications. First, to improve the quality and access to health services in the region for harnessing of demographic dividend, a public-private partnership framework should be put in place, government expenditure enhanced (both in amount allocated and effectiveness/efficiency in spending - reducing leakages and mis-targeting). The quality of health can be improved by lowering the dependency ratio among the household heads. Increased government expenditure can be achieved by placing more emphasis on: fiscal consolidation and expenditure prioritization; tax reforms; enhancing domestic resource mobilization and governance; and curbing illicit financial flows and corruption.

Secondly, to improve the quality and access to education, there is need to focus on government provision of education and effective governance This implies that without effective governance, high government expenditure in education alone may not necessarily translate in quality and accessible education.

Finally, COMESA governments should put more emphasis on the use of fiscal policy to improve family planning and governance in the region both in the short run and in the long run as a strategy to harness demographic dividends. Improving family planning would require provision of family planning services, including contraceptives, improving child survival, and empowering women. These should be integrated in the countries' long term strategic development plans.

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The Impact of the Demographic Structure on Energy Demand in COMESA

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Abstract

The increase in Africa's working age population means that the COMESA region needs to plan its energy infrastructure accordingly. Using time series data (1990 to 2016) from nine COMESA countries, this paper explored the possibility of improving energy demand estimation procedure through decomposing population variable. Through a Seemingly Unrelated Regression model, the paper found that different population categories put varying amount of pressure on electricity demand. The paper provides evidence that in most of the selected countries the working age population has the largest effect on electricity demand. This implies that the COMESA region needs to plan for this change in demographic structure to ensure sufficient electricity supply in the region. However, available information shows that current energy Master Plans of several COMESA Member States have not considered the impact of demographic structure in their energy demand projections, which could lead to underestimation of future energy needs and in turn lead to insufficient energy supply. Member States should take into account the demographic structure in developing their energy demand plans.

Key words: Demographic transition, demographic structure, working age population, energy demand, COMESA

1.0 Introduction

1.1 Background

Africa is experiencing changes in its demographic structure, by 2050, its population will account for more than 25 percent of the global population (Mabrey, 2016). Demographic transition is primarily a function of decline in fertility. The change in age structure means that, by 2030, sub-Saharan Africa will represent nearly two-thirds of the growth in the world's workforce (Ahmed et al., 2014). The potential increase in the workforce presents the continent with a window of opportunity akin to the "Asian Miracle". However, countries can only enjoy this opportunity if they make the necessary investments, in young people through education and training thus increasing, economic productivity (Drummond, Thakoor, & Shu, 2014).

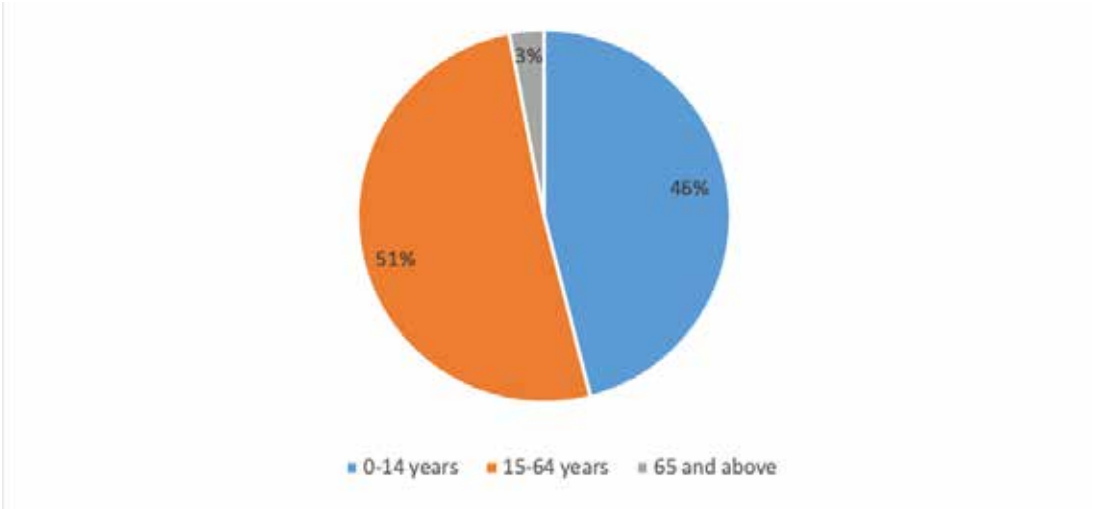
The International Energy Agency (2015) states that when a country is undergoing a demographic transition, it also experiences a huge pressure on energy demand. This is due to the high propensity of the working age population to engage in energy-intensive technologies. The key opportunity in harnessing demographic dividend lies in employing the working-age share of the population productively, which translates to increased output per capita and economic growth (Canning, Raja, and Yazbeck, 2015). This requires enhancement of energy supply to meet the increasing demand.

Amjad (2013) indicates that one of the reasons why Pakistan has not harnessed its demographic dividend is due to energy supply shortage. Energy is a key input in all sectors of the economy. For countries to effectively harness their demographic dividend through prioritizing investments into industrialization, information technology and communication (ICT), health care, and education, it is important to optimise investments in the energy sector.

1.2 Demographic Structure in the COMESA Region

Working age population (15-64 years) has been traditionally accounting for bigger share of the population within the COMESA Region. Figure 1 presents the population structure, an average for 1998 to 2017. The Figure shows that over this period, on average, working age population accounted for 51 % of the total population followed by young population (0-14 years) which accounted for 46% of the total population whilst old population (65 years and above) accounted for a paltry 3% of the total population.

Figure 1: COMESA's Demographic Structure

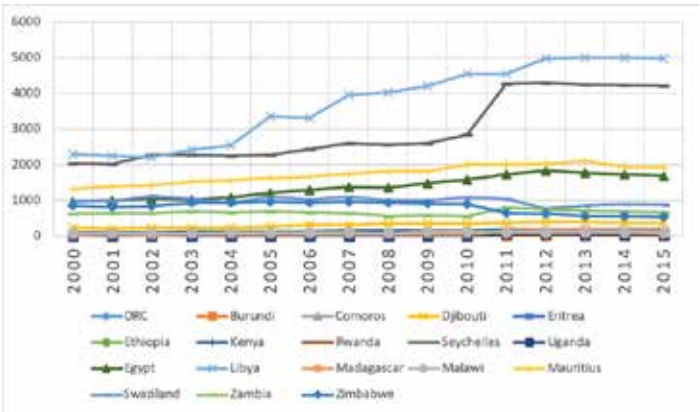


1.3 Energy Sector in COMESA

The COMESA region is rich in potential electrical power generation, but the region faces severe energy deficit (Verhaeghe & Woolfrey, 2017). In COMESA, only 45% of the population have access to electricity (COMESA, 2017). This may decrease given that the African continent has the highest number of people without access to electricity and is experiencing a rapid growth in population (International Energy Agency, 2017).

Given a world average electricity consumption of 3128 kWh, it is apparent from Figure 2 that consumption of electricity in the COMESA Region is lower than the world with the exception of Libya and Seychelles whose consumption surpassed world average in 2005 and 2011 respectively. The consumption data presented in Figure 2 only takes into account electricity consumed from the national grid and excludes independently generated and consumed electricity.

Figure 2: COMESA Final consumption of electricity per Capita (kWh) (2000 – 2015)



Source: COMESA (2018), COMSTAT Statistics

Figure 2 shows that electricity consumption per capita has remained low in the region because of the rapid increase in population which is outpacing electricity supply. (Nondo, Kahsai, & Schaeffer, 2012). The region, like the rest of Africa, will continue to experience energy deficit if no measures are taken to boost the supply. Deutsch & Timpe (2017) emphasizes the importance of understanding how current demographic changes in an economy affect energy demand to develop accurate energy supply systems and policies. The effects of the demographic structure on energy demand in COMESA are not known.

1.3.1 Forecasted Energy Demand for Eswatini and Seychelles

This section presents a review of two COMESA Member States[8] master plans and strategies to determine whether demographic structure has been considered in their formulation.

1.3.1.1 Eswatini

The Kingdom of Eswatini developed a national energy master plan in 2017. A detailed energy demand assessment for the period 2015 to 2035 was done using the Long-range Energy Alternatives Planning System (LEAP) software (Heaps, 2016). An energy demand accounting model for Eswatini was developed and three demand projections formulated based on three scenarios– reference, high, and low growth (Government of Eswatini, 2017). These scenarios were differentiated by assumptions on the GDP growth rate and the electrification rate in the residential sector. A standard average annual population growth rate of 0.8 to 1.2% was applied to all three scenario assumptions (Government of Eswatini, 2017). Table 1 provides detailed scenario assumptions.

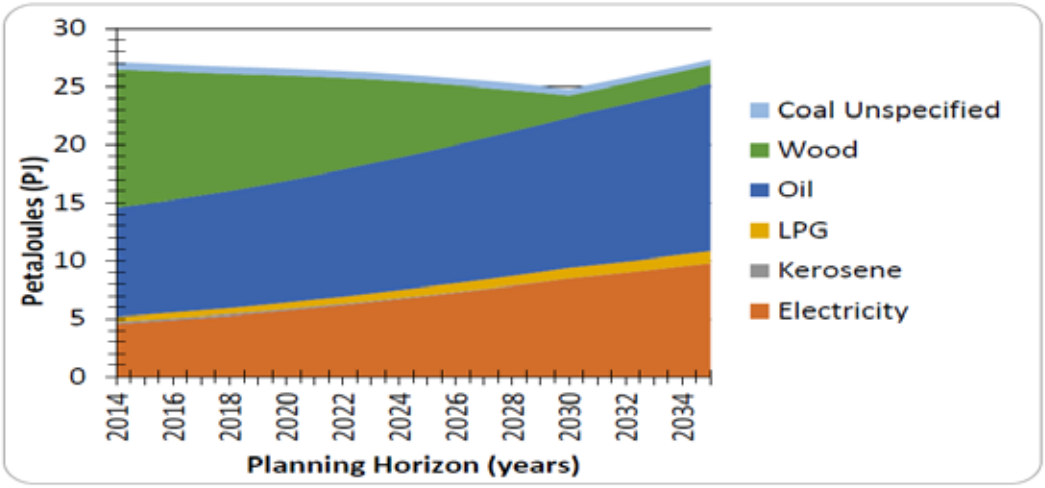
Table 1: Key Scenario Assumptions

	Reference	High	Low
Annual GDP growth rate	1.2%: 2014 to 2030 3%: 2030 to 2035	1.8%: 2014 to 2020 3%: 2020 to 2025 3.5%: 2025 to 2035	0.9%: 2014 to 2020 1.8%: 2030 to 2035
Electrification rate	100% achieved in 2030 (0.5% growth per year)	100% achieved in 2022	100% achieved in 2035 (0.5% growth per year)
Annual population growth	1.2% to 0.8% : 2014 to 2035		

In the reference scenario, total energy demand is projected to increase slightly from 26.1 petajoules (PJ) in 2014 to 27.3 PJ in 2035 as shown in Figure 3. The demand for oil products will grow by almost 50% in 2035 with 95% of this growth coming from the transport sector (Government of Eswatini, 2017). The electricity demand will almost double by 2035, to reach 2726 GWh (Government of Eswatini, 2017). As living standards improve, people consume more modern energy hence kerosene and wood usage will decline thus reducing total energy demand.

8 Energy Master Plans for other countries were either unavailable online or they forecasted only up to 2020 hence the reason why only two countries were chosen for this review.

Figure 3: Final Energy Demand by Fuel Types



Source: Eswatini Energy Master Plan 2015-34 (Government of Eswatini, 2017)

Notes: Coal unspecified is coal used in commercial and Government services which does not include coal fired power plants.

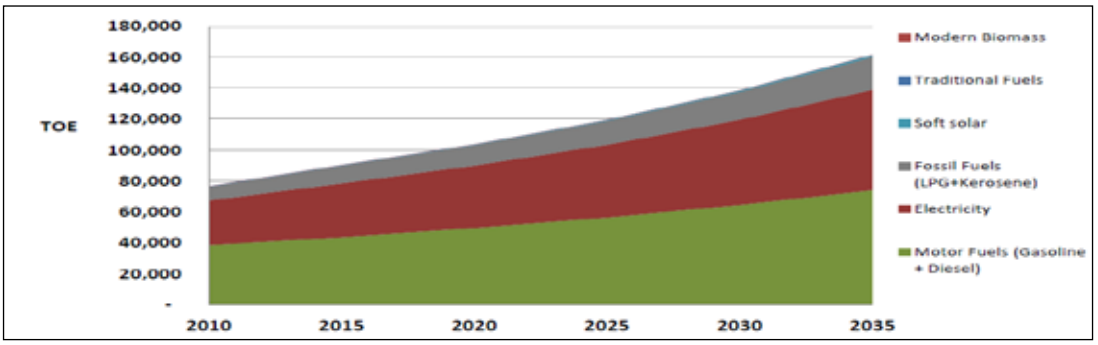
The Eswatini energy master plan mainly focuses on economic growth and future electrification rates of the residential sector as the drivers of future energy demand. While population growth has been considered in the energy estimates, the master plan applies a standard rate of population growth without considering the future changes in the age structure. Recent literature from some Asian countries indicate that national energy demand estimates should consider the demographic structure and population growth to avoid under estimation of future energy needs (Bhattacharyya, 2015).

1.3.1.2 Seychelles

For decades, using oil powered generators has been the most economical way to generate electricity in Seychelles but the oil price increase in 2008 proved that heavy reliance on oil is risky. Thus, the ability to supply energy at reasonable and predictable prices has become a key policy issue (The Seychelles Energy Commission, 2015).

Seychelles' Energy Commission envisages that, the household sector projected increase in energy demand will result from the number of dwellings (houses) and dwelling characteristics such as the size, annual energy requirement per end-use, penetration of energy forms, and equipment efficiencies. Considering the structure of the population can improve the precision of estimating future energy demand. Even though electricity demand is projected to increase as indicated in Figure 4, like Eswatini, the Seychelles Integrated Energy Study 2015-2035 does not refer to the effects of the expected demographic structure on electricity demand, which could lead to underestimation in energy demand.

Figure 4: Final Energy Demand By Fuel Types



Source: The Seychelles Energy Commission (2015)

1.4 Objectives of the Study

The overall objective of this paper is to explore the possibility of improving energy demand estimation procedure through decomposing population variable. The specific objective is to examine the impact of an increase in the working age population on energy consumption in the COMESA region.

2.0 Review of the Literature

2.1. Theoretical Review of Energy Demand

Early economic theories viewed population as an outcome variable, which implies that an increase in resources was associated with an increase in population (Malthus, 1978). According to Mishra (2011), demand is a function of desire, ability to pay and willingness to spend. This forms the bases of selecting variables to be included when modelling Electricity demand.

According to Weil and Wilde (2010), the Malthusian theory of population and economic growth has two key components. First, there is a positive effect of the standard of living on the growth rate of the population, either from a purely biological effect of consumption on birth or death rates or a behavioural response on the parts of the parents' response to their economic circumstances. Second, because of the existence of some fixed resources such as land, there is a negative feedback from the population size to the standard of living. This theory shows presents the link between population and other economic variables. The current study therefore builds on these theories and seeks to establish the nature of the relationship that exists between energy demand and different categories of the population variable in the COMESA region.

2.2. Demographic Structure as a Driver of Energy Demand

Energy is key for improvement of social and economic welfare. It has been essential for continued economic activities industrial revolution, and its absence limits economic growth and diminishes standards of living (Medlock, 2009). Whilst consumption varies widely among households with nearly identical characteristics (Parker, et al., 2006), lack of modern energy services is a primary cause of low levels of economic and social development (Medlock, 2009).

Energy demand has been a subject of interest among researchers since the 1970 oil crisis. It has therefore become an essential component for energy planning, formulating strategies, and shaping energy policies (Bhattacharyya, 2015). Yeager (2012) identifies three basic drivers of energy demand namely; population, economic activity, and technological performance. These drivers form the basis of most energy demand models.

Improvement in economic activity which is a result of several factors such as industrialisation requires vast amount of energy. Moreover, an increase in population results in an increase in the number of people using energy hence energy demand increases. The advancement in technology plays a huge role on energy demand due to its nature. However, it is argued that as technology advances it becomes more energy efficient hence the lesser the total net energy that is consumed (Tunali, 2016). The three drivers (economic activity, population changes, and technology advances) have guided numerous empirical studies in energy demand analysis literature, and some evidences in line with the current study.

2.3. Empirical Literature

Empirical literature determining the effects of different variables on energy consumption is vast. Studies focus on the impact of economic growth, population, electricity prices, financial development and urbanisation on energy consumption. However, the impact of demographic structure and ICT has received little attention.

Hasanov & Mikayilov (2017) examined the impact of age groups (0-14, 15-64, and 65 and above) on residential electricity consumption in Azerbaijan using a Pooled Mean regression analysis and found that the age group 15-64 had the highest effect on electricity consumption compared to the other age groups. Kim & Byeongseon (2016) investigated the impact of an aging population (above 65 years) on the demand for energy using a dynamic panel model composed of 53 countries for the period 1976 to 2009. They found that the impact of an aging population on energy use was low when this population increased.

Garau, Lecca, & Mandras (2013) evaluated the impact of demographic change on energy using an overlapping generations general equilibrium model for Italy. They found that an ageing population led to a reduction in energy use. On the contrary, Tonn & Eisenberg (2007) used qualitative analysis to estimate the impact of different age group on energy demand and concluded that elderly persons use more residential energy than younger persons in the United States (US).

Sadorsky (2015) used a Pooled Mean Regression analysis to study the impact of ICT on electricity consumption in 19 emerging economies and found that ICT has a positive relationship with electricity consumption. Salahuddin & Alam (2016) studied the impact of ICT on electricity consumption and Gross Domestic Product (GDP) for OECD countries and found that ICT use had a positive impact on electricity consumption and stimulates economic growth. Using a Pooled Mean Regression analysis, Tunali (2016) investigated the effect of ICT on electricity consumption in the European Union and found that an increase in ICT usage increased electricity consumption in the long run.

2.4. Overview of Literature

The reviewed studies show that a change in demographic structure has an effect on energy demand. From the literature, the impact of demographic structure, ICT and other variables on energy consumption have been studied in a number of countries but no literature is available on studies conducted in the COMESA region. Some studies include population growth in understanding the impacts of macroeconomic variables on energy consumption but very few studies include the impact of a growing working age population on energy consumption. Therefore this study contributes to the existing literature by estimating the effects of the demographic structure on energy consumption for the COMESA region.

3 Methodology

3.1. Model Specification

The study applied a Seemingly Unrelated Regression Model to identify factors associated with electricity consumption in selected COMESA member countries. The advantage of this method is that it jointly estimates individual equations (panel regression) thus taking into account possible interdependences between the different cross section unit (in this case individual countries included in the model) (Inglesi-Lotz and Blignaut, 2011). For the selection of regressors of the model, the study builds on the models estimated by Rahimi & Rad (2017). The orginal model by Rahimi & Rad (2017) is as follows:

$$lnECpc_{it} = \beta_0 + \beta_1 lnGDPpc_{it} + \beta_2 lnINT_{it} \qquad (1)$$

This model estimated the impact of ICT (using the number of internet users per 100 people) and economic growth (using GDP per capita) on electricity consumption (using electricity consumption per capita). This study modified and expanded the equation by Rahimi & Rad (2017) to include population variables (young, working, and old) and mobile phone usage (Equation 2). Disaggregating the population variable into these categories is grounded in the premise that age does influence consumption of electricity. However, the question of which age group puts more presure on energy demand in the COMESA region remains an empirical question. Employing a model that estimates coefficients for individual countries was deemed necessary since COMESA Member States are of different economic sizes. On the other hand, being in one common market renders some attibutes correlated hence the need for the modelling approach to take into account any possible correlation between the regressors.

$$lnECpc_{it} = \beta_0 + \beta_1 lnGDPpc_{it} + \beta_2 lnINT_{it} + \beta_3 lnMOB_{it} + \beta_4 lnYPOP_{it} + \beta_5 lnWPOP_{it} + \beta_6 lnOPOP_{it} + \varepsilon_{it} \qquad (2)$$

Where, ln denotes the natural logarithm;

$i = 1, \dots, N$ for each country in the panel

$t = 1, \dots T$ refers to the time period

β are parameters to be estimated

$ECpc$ denotes electricity consumption per capita

$GDPpc$ denotes GDP per capita

INT denotes internet users per 100 people

MOB denotes mobile phone users per 100 people

$WPOP$ denotes working age population

$YPOP$ denotes young population

$OPOP$ denotes old population.

3.2. Data Description and Measurement

Energy consumption is measured by electricity consumption (Kwh per capita), GDP per capita is measured in constant 2005 US$, working age population is between 15-64 years, young population is between 0-14 years, old population is 65 years and above, the number of internet users per 100 people and the number of mobile phone users per 100 people are used as proxies for ICT. A summary of the data used and expected signs is provided in Table 2.

Table 2: Summary of Variables used in Model

Variable	Categories of Variable	Apriori expectation
Electricity Consumption per capita (dependent variable)	continuous	
GDP Per capita	continuous	+
Population	Young population (YPOP), working age population (WPOP), old population (OPOP)	+
Internet users per 100 people	Continuous	+
mobile phone users per 100 people	Continuous	+

The study used time series data for the period 1990 to 2016 obtained from World Development Indicators (World Bank, 2018). The study covered eight COMESA Member States: Ethiopia, Zambia, Democratic Republic of Congo (DRC), Eswatini, Egypt, Mauritius, Zimbabwe, and Kenya. The Member States were selected based on the availability of data.

4. Estimation and Discussion of Results

4.1 Descriptive Statistics

Table 3 presents the descriptive statistics. The results show that variation between countries is much wider compared to variation within countries. This is in line with expectation since, even though the countries are in one region, the size of their respective economies vary.

Table 3: Descriptive Statistics

C		Mean	Std. Dev	Min	Max	Obs
gdp	overall	1852.802	1926.881	163.6233	9822.008	N = 243
	between		1910.559	267.5014	6322.03	n = 9
	within		674.3955	-761.372	5352.779	T = 27
electric	overall	527.0506	545.1418	21.62727	2293.999	N = 243
	between		528.4976	37.27648	1512.051	n = 9
	within		218.8112	-314.414	1308.999	T = 27
internet	overall	6.609818	10.48895	0.001	53.2262	N = 243
	between		4.848077	0.783567	16.42561	n = 9
	within		9.436073	-9.81479	43.41041	T = 27
mobile	overall	25.2461	35.41078	0.001	144.2396	N = 243
	between		13.12439	7.737136	51.89969	n = 9
	within		33.16897	-26.4452	117.586	T = 27
working	overall	1.76E+07	1.61E+07	391020	5.88E+07	N = 243
	between		1.56E+07	566881.1	4.38E+07	n = 9
	within		6319903	3842551	7.34E+07	T = 27
young	overall	1.38E+07	1.18E+07	238908	4.21E+07	N = 243
	between		1.20E+07	291173.8	3.31E+07	n = 9
	within		3203534	2912263	2.57E+07	T = 27
old	overall	1139328	1187259	23418	4889885	N = 243
	between		1205206	32568.96	3628491	n = 9
	within		336328.9	98460.73	2400722	T = 27

4.2. Diagnostic Tests

4.2.1 Panel Unit Root Tests

Before running the econometric model, the study undertook diagnostic tests on the data. The variables were tested for stationarity using a number of panel unit root tests which included the Levin, Lin, & Chu (LLC) test (Levin, Lin, & Chu, 2002), Im, Pesaran & Shin (IPS) test (Im, Pesaran, & Shin 2003), and Augmented Dickey-Fuller (ADF) test (Dickey & Fuller, 1981). Table 5 shows the results obtained from the LLC, IPS, and ADF tests. The results suggest that electricity consumption per capita, GDP per capita, internet usage per 100 people, working age population, and young population are non-stationary at levels. This implies that using these variables in the current form (at levels) will yield spurious result. As a result, the variables were differenced to achieve stationarity.

Table 4: Panel Unit Root Test Results

Test Statistic	LLC	IPS	ADF
A: Level			
Electricity Consumption (per capita)	-0.26994 (0.3936)	2.04226 (0.9794)	7.85400 (0.9807)
GDP (per capita)	-2.31202 (0.0104)	-0.36998 (0.3557)	17.4054 (0.4954)
Internet Users (per 100 people)	1.68201 (0.9537)	2.29410 (0.9891)	7.87745 (0.9804)
Mobile Phone Users (per 100 people)	-4.14840 (0.0000)***	-0.12629 (0.4498)	16.8806 (0.5313)
Working age population (Total)	61.0273 (1.0000)	-1.58388 (0.0566)*	38.3366 (0.0035)**
Young Population (Total)	-1.06948 (0.1424)	0.32678 (0.6281)	18.9522 (0.3948)
Old Population (Total)	-3.20439 (0.0007)***	-3.77530 (0.0001)***	46.2555 (0.0003)***
B. First differences			
Electricity Consumption (per capita)	-5.49801 (0.0000)***	-4.60116 (0.0000)***	56.0362 (0.0000)***
GDP (per capita)	-5.77744 (0.0000)***	-5.51103 (0.0000)***	63.1670 (0.0000)***
Internet Users (per 100 people)	-4.80998 (0.0000)***	-3.86605 (0.0001)***	46.8018 (0.0002)***
Mobile Phone Users (per 100 people)	-2.08275 (0.0186)*	-2.57280 (0.0050)**	37.6464 (0.0043)**
Working age population (Total)	209.209 (1.0000)	0.33132 (0.6298)	16.7182 (0.5426)
Young Population (Total)	-1.02207 (0.1534)	0.07100 (0.5283)	15.1819 (0.6494)
C. Second differences			
Working age population (Total)	-5.08007 (0.0000)***	-4.77941 (0.0000)***	54.6593 (0.0000)***
Young Population (Total)	-5.08007 (0.0000)***	-3.72147 (0.0001)***	45.0577 (0.0004)***

***, **, and * show 1%, 5% and 10% significance levels

Note: all variables are expressed in natural logarithms

After applying panel unit roots tests, the Pedroni (2004) residual co-integration test was employed to find out whether there exists a long-run equilibrium relation between the variables. The results from the Pedroni residual co-integration test as shown in table 6 indicate the presence of co-integration among 4 variables in the model. Therefore, it is concluded that there exists a long-run relationship between the variables for the panel.

Table 5: Pedroni residual Co-integration Test

Panel co-integration statistic	Statistics	Probability
Within Dimension		
Panel v-Statistic	-0.509042	0.6946
Panel rho-Statistic	3.141118	0.9992
Panel PP-Statistic	-2.504877	0.0061***
Panel ADF-Statistic	-4.436641	0.0000***
Between Dimension		
Group rho-Statistic	4.248314	1.0000
Group PP-Statistic	-11.87790	0.0000***
Group ADF-Statistic	-3.380758	0.0004***

*** shows 1% significance levels

Additional diagnostic test are presented in the appendices section. The Breusch Pagan Test for heteroscedasticity reveal that the data suffers from heteroscedasticity. The Variance Inflation Factor (VIF), which is a test for multicollinearity shows that there is no multicollinearity between variable. The Skewness and Kurtosis tests for normality show that the data is normally distributed.

4.3. Seemingly Unrelated Regression Model (SUR)

Table 6 presents results from the SUR estimation. GDP was found to explain electricity consuption in Ethiopia, Eswatini, Mauritius, and Kenya. This implies that the economies of most COMESA countries are service as opposed to industry based and/or the main economic activities do not use electricity as a major input in the production process. Internet connection explains electricity consumption in only two of the nine COMESA countries, Ethiopia and Zimbabwe. Mobile phones explain electricity consumption in Egypt, Mauritius, Zimbabwe, Kenya, and Sudan.

We focus our interpretation of results on the population variable since it forms the basis of our energy demand modelling approach. In most of the eight COMESA countries (with an exception of Egypt), an increase in young population is associated with a decrease in energy demand. This is in line with expectation since the propensity and ability of this age group to engage in electricity intensive activities is limited. For instance, a 1% increase in young population in DRC and Mauritius was found on average to be associated with 13.52% and 0.01% decrease in electricity demand, respectively.

Regarding the working age population, in most countries, an increase in working age population was found to be associated with an increase in electricity demand with the exception of Eswatini and Zimbabwe where the association was positive but insignificant. For example, a 1% increase in working population in Ethiopia and Zambia was found to be associated with 8.01% and 22.27% increase in electricity demand. Old age population was found be explain electricity demand in Ethiopia, Zambia, DRC, Mauritius, and Kenya.

Table 6: Seemingly Unrelated Regression (SUR) Model

	Ethiopia	Zambia	DRC	Eswatini	Egypt	Mauritius	Zimbabwe	Kenya
Variable	**Coef. (Std. Err.)**	**Coef. (Std. Err.)**	**Coef. (Std. Err.)**	**Coef. (Std. Err.)**	**Coef. (Std. Err.)**	**Coef. (Std. Err.)**	**Coef. (Std. Err.)**	**Coef. (Std. Err.)**
GDP	0.334***	-0.086	0.028	-0.589	0.548	0.329**	-0.248	0.871*
	(0.105)	(0.105)	(0.427)	(0.316)*	(0.394)	(0.142)	(0.242)	(0.461)
Internet connection	0.030***	-0.001	-0.025	-0.002	0.024	-0.003	0.113**	-0.019
	(0.009)	(0.007)	(0.020)	(0.005)	(0.005)***	(0.004)	(0.056)	(0.012)
Mobile phone	0.013	-0.007	-0.005	-0.001	0.037***	0.128***	-0.107**	0.024*
	(0.008)	(0.006)	(0.018)	(0.004)	(0.007)	(0.011)	(0.042)	(0.013)
Young population	-1.264	0.481	-13.518**	-0.241	1.616***	-0.013***	-35.646***	0.819
	(3.933)	(4.078)	(6.944)	(0.267)	(0.504)	(0.004)	(7.507)	(1.288)
Working age population	8.010***	22.268***	-14.639***	0.536	7.011***	3.770***	-1.131	12.749**
	(0.535)	(3.341)	(4.366)	(1.660)	(1.045)	(0.566)	(2.892)	(5.211)
Old age population	9.950***	5.545***	9.888***	1.160	2.095	0.719*	-4.980	9.941***
	(1.733)	(1.364)	(3.309)	(1.262)	(1.478)	(0.371)	(4.098)	(2.412)
Constant	8.618***	22.641***	-5.777*	6.199***	7.831***	8.326***	5.918***	5.220
	(0.353)	(2.444)	(2.978)	(1.222)	(0.254)	(0.250)	(1.735)	0.871

* p<0.1; ** p<0.05; *** p<0.01

Note: Variables are in log format and differenced to correct for Unit root

4.4. Dumitrescu-Hurlin Causality Test

The paper employed a Dumitrescu-Hurlin (2012) causality test to determine the causal link between the variables of model (1). Table 7 shows that an increase in the working age population, economic growth, and internet usage causes increase in electricity consumption in COMESA countries. Moreover, the causality results also suggest that an increase in electricity consumption, mobile phone usage, internet usage, and working age population causes economic growth. These findings are similar to the findings of Salahuddin & Alam (2016) for OECD countries.

Table 7: Dumitrescu-Hurlin Causality Test Results

Null Hypothesis:	W-Stat.	Zbar-Stat.	Prob.
lelectric does not homogeneously cause lgdp	6.21546	4.82174	1.E-06***
lgdp does not homogeneously cause lelectric	5.57354	4.04664	5.E-05***
linternet does not homogeneously cause lgdp	6.78570	5.51029	4.E-08***
lgdp does not homogeneously cause linternet	1.75577	-0.56323	0.5733
lmobile does not homogeneously cause lgdp	5.95775	4.51057	6.E-06***
lgdp does not homogeneously cause lmobile	3.41079	1.43517	0.1512
lworking does not homogeneously cause lgdp	12.8484	12.8308	0.0000***
lgdp does not homogeneously cause lworking	5.74555	4.25434	2.E-05***
linternet does not homogeneously cause lelectric	6.16595	4.76195	2.E-06***
lelectric does not homogeneously cause linternet	0.77986	-1.74162	0.0816**
lmobile does not homogeneously cause lelectric	7.39234	6.24279	4.E-10***
lelectric does not homogeneously cause lmobile	3.60052	1.66427	0.0961**
lworking does not homogeneously cause lelectric	8.44905	7.51875	6.E-14***
lelectric does not homogeneously cause lworking	7.28677	6.11532	1.E-09***
lmobile does not homogeneously cause linternet	3.99909	2.14552	0.0319**
linternet does not homogeneously cause lmobile	21.2166	22.9353	0.0000***
lworking does not homogeneously cause linternet	10.2967	9.74974	0.0000***
linternet does not homogeneously cause lworking	4.11399	2.28427	0.0224**
lworking does not homogeneously cause lmobile	4.46852	2.71236	0.0067**
lmobile does not homogeneously cause lworking	9.58161	8.88628	0.0000***

5.0 Conclusion and Policy Implications

This paper evaluated the association between different population categories and electricity demand in selected COMESA countries. Different age groups add varying amount of pressure on electricity demand. Most importantly, the effect of a particular age group on electricity demand varies across countries. This implies that plannning for electricity demand at a regional level should not over shadow the need for COMESA Member States to customise energy investment

plans to their respective contexts.

An increase in the working age population and ICT usage increases the demand for electricity consumption in the long run in the COMESA region. Specifically, an increase in the working age population has the largest effect on electricity consumption compared to the other population age groups. The estimated increase in the working age population will inarguably put pressure on energy demand. This implies that COMESA needs to plan for the change in demographics to ensure sufficiency in energy supply in the region, curb energy deficits as well as low energy consumption per capita.

Therefore, energy planning decisions should take into account the impact of the increase in the working age population on electricity consumption. An underestimation of energy demand can lead to under investments in energy production, resulting in energy shortages which could compromise development prospects in COMESA. To improve the energy systems in the region COMESA should:

- Ensure that energy management strategies take into account demographic structure. Considering demographic structure when preparing Energy Master Plans will ensure that ivestments in electricity production projects sufficiently matches changes in electricity demand;
- Develop and frequently update energy databases; and
- Develop and revise energy demand models to reflect each Member State's context.

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Appendices

Appendix 1: Breusch-Pagan / Cook-Weisberg Test for Heteroskedasticity

Ho: Constant variance	
Variables: fitted values of electriclog	
chi2(1)	3.56
Prob > chi2	0.0592

Appendix 2: Variance Inflation Factor (Multicollinearity Test)

Variable	VIF	1/VIF
workinglog	1.1	0.36895
younglog	1.83	0.41969
oldlog	1.82	0.41973
internetlog	1.69	0.78829
mobilelog	1.24	0.81724
gdplog	1.4	0.249996
Mean VIF	1.513333	

Appendix 3: Skewness/Kurtosis Tests for Normality

Variable	Observations	Skewness	Kurtosis	Chi2	Prob
electriclog	243	0.1037	0.0000	41.88	0
gdplog	243	0.9177	0.0352	4.48	0.1064
younglog	243	0	0.0097	26.08	0
workinglog	243	0	0	28.79	0
internetlog	243	0.0111	0	.	0
mobilelog	243	0.0009	0	.	0
oldlog	243	0.0004	0.0003	20.71	0

Appendix 4: Woolridge Test For autocorrelation in Panel Data[9]

F(1,8)	141.031
Prob > F	0.001

9 As Normality and Woolridge tests reject the null hypothesis of the specification problems, the paper corrected for these issues by differencing the data and added more lags to the estimation prior to running the model

Harnessing the Demographic Dividend through Commercialization of Local Research in COMESA

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Abstract

This study investigated the contribution of new knowledge and innovation as measured by the number of patents & scientific journals as well as the impact of youthful labour force on the manufacturing sector Gross Domestic Product (GDP). It employed the Fixed Effects (FE) method on a sample panel of 19 Common Market for Eastern and Southern Africa (COMESA) Member States for the period 2008 to 2016.

The results showed that the youthful labour force, capital and mobile cellular subscriptions are important factors in generating growth in manufacturing sector output in COMESA. The youth gain by undertaking research and participating in its commercialization in the manufacturing sector. Access to mobile phones and ICT services play a key role in sharing academic knowledge and research outputs with the manufacturers.

The paper recommends that COMESA should to incentivize the youth to participate in research carried out by universities and public research institutes that will add to their stock of skills. This will in turn act as an engine of growth in the manufacturing sector through innovative activities and direct employment into the manufacturing sector. In addition there is need to increase support for provision of quality tertiary education that contextualizes research, innovation and entrepreneurship.

1.0 Introduction

1.1 Background

Countries in Sub-Saharan Africa (SSA) have the highest proportion of young people in the world, with over 70 percent aged below 30 years[10]. This segment comprises of individuals who are building skills hence very important for economic growth and development. Economic growth and employment creation for the youth are a major challenge globally and in COMESA Member States(Anyanwu, 2014). Youth unemployment rates remain high especially in SSA (World Bank, 2018b), which calls for innovative approaches to address the problem. Over time several approaches have been used across the world that have led to quantitative and qualitative changes in the job market (Thurik, 2001). The evidence points at a shifting economic system, with one manifestation being a divergence in job creation and reduction of unemployment across countries. The forerunners like the Netherlands, Denmark and United Kingdom have shifted towards an entrepreneurial economy (Blanchard & Katz, 1997; Siebert, 1997); while the laggards are still obsessed with perfecting the managed economy like Germany, or rethinking the managed economy, like France (Nickell, 1997). An entrepreneurial economy is one where entrepreneurship plays a key role in generating economic growth and it's not organizationally based, but upon persons or individuals while a managed economy is one in which the framework and general policies are regulated by the government.

Investment in Research and Development (R&D) is one of the approaches used to address the problems of low economic growth and youth unemployment. Universities, Technical Vocational Education and Training Institutions (TVETs) and research institutes have continued to conduct research, which is considered a key driver of long-term economic growth. This is the primary basis for competitiveness in world markets and part of the response to many societal challenges (Audretsch & Thurik, 2001). In COMESA Member States, public expectations from technological innovations are evolving in line with social concerns (e.g. unemployment, sustainable development, youthful populations), while the innovation process itself is facing major challenges such as patenting, lack of adequate facilities offering incubation and acceleration services among others.

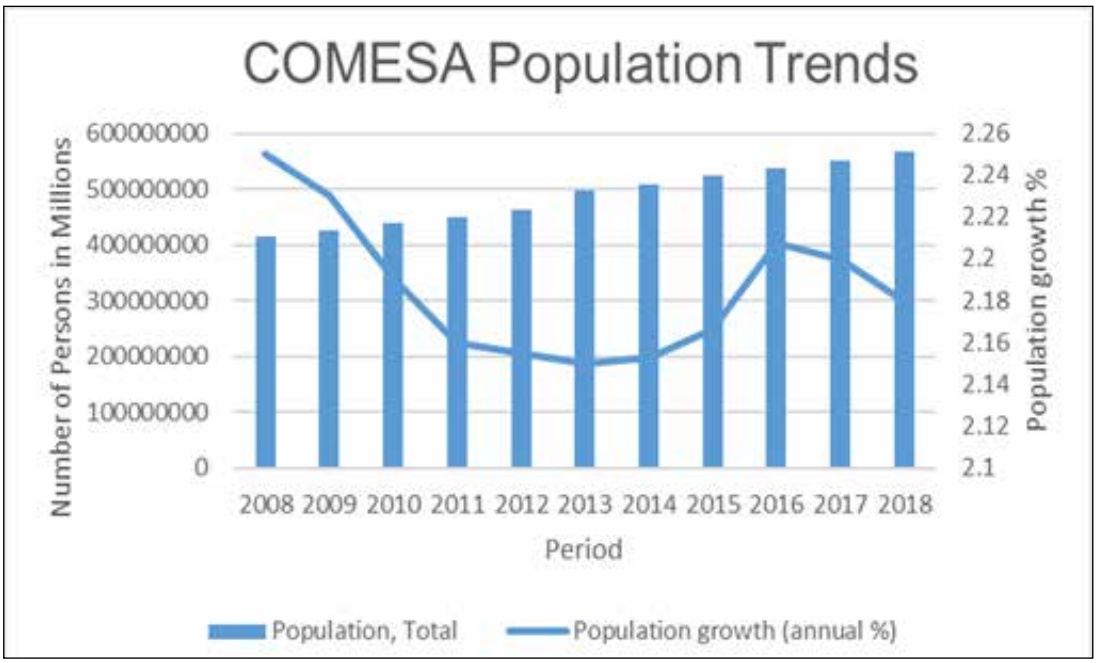
Commercialization of research has therefore become a central concern for applied economics and economic policy (Arvanitis et al., 2008). Tanha et al. (2011) defines commercialization of research as the process of converting research output into marketable products. It is considered a key component of reinvigorating the manufacturing sector, generating highly productive jobs, accelerating economic growth and reducing youth unemployment (World Bank, 2012).

1.2 Population Structure in COMESA

COMESA's population was estimated at 555 million persons as at 2017, and this was projected to grow at an annual rate of 2.2 percent (African Development Bank Group, 2018). With this high growth rate, COMESA's population will be expected to have added approximately 14 million persons by the end of 2018 (See Figure 1).

10 Estimate obtained from http://www.unesco.org/news/en/unesco viewed on 17th July 2018

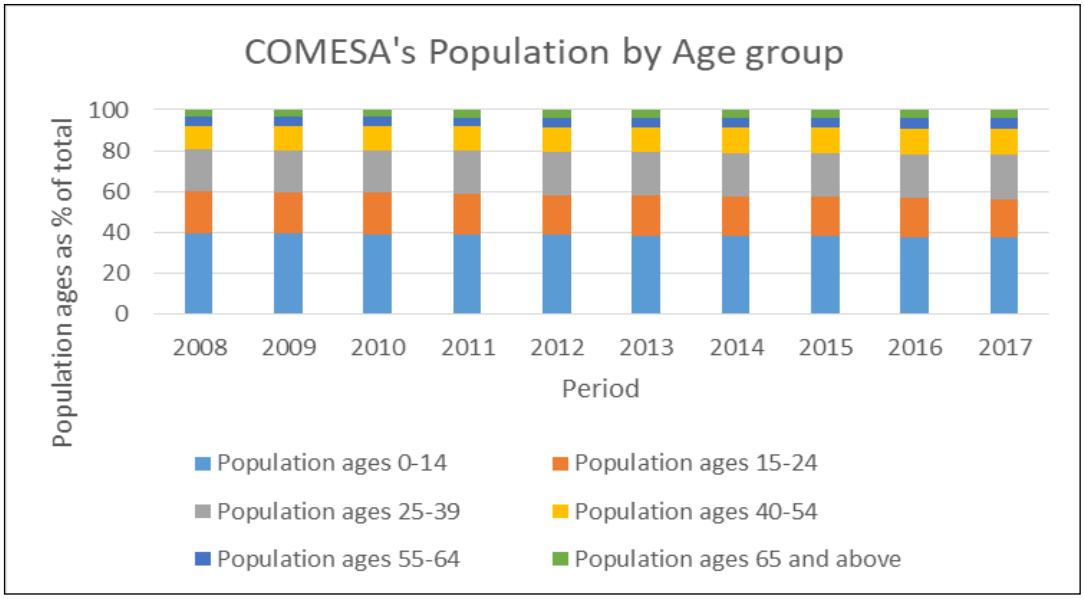
Figure 1: Population Trends in COMESA



Source: Africa Development Bank database 2018

Figure 2 below that there is a high proportion of younger people within the COMESA population as a whole, with about 39% of the COMESA population being under the age of 15. According to the United Nation Population Division's current projections, nearly all of these countries are a few decades away from entering the "demographic window of opportunity". This is a period that is defined by: low proportions of children and seniors, high proportions of adults in their prime working ages of 25 to 55 years and an average family size that is small enough for parents. COMESA Member States can harness the demographic dividends arising from this window of opportunity by making strategic investments to improve education and skills development, health, economic reforms and job creation. In addition, given the relatively high rate of unemployment in these countries, the unemployed youth can actively take part in research activities that will give them insight on what marketable products they can come up with.

Figure 2: COMESA's Population by Age Group

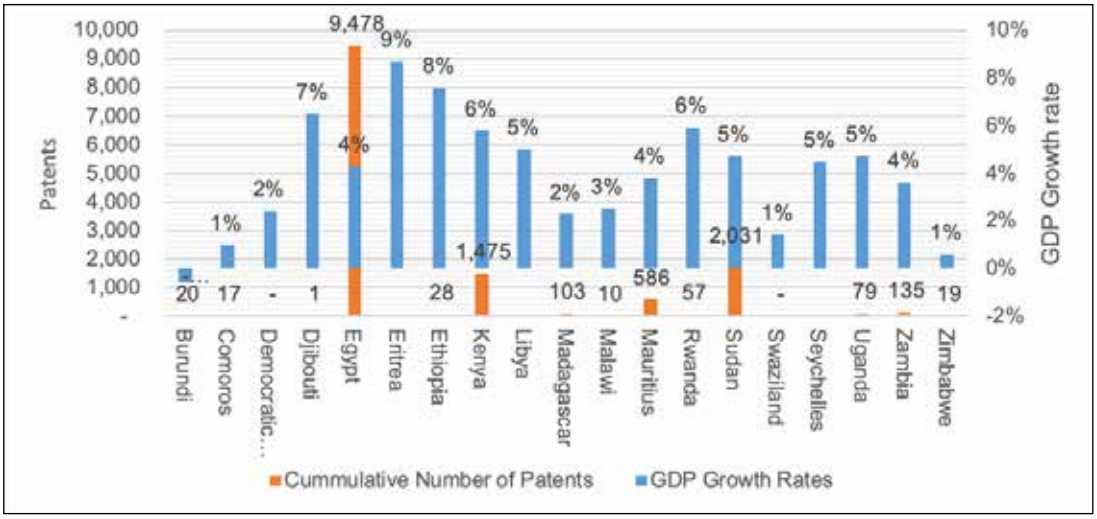


Source: Africa Development Bank database 2018

1.3 Patents and Economic Growth in COMESA

Figure 3 shows that COMESA Member States have patents, which demonstrates that knowledge is being produced. New knowledge out of research is imperative in providing the base for innovative products. Innovations are manifested by the number of patents. However, the rate of commercialization of research in African countries remains low compared to Organization for Economic Co-operation and Development (OECD) countries (Adoyo, 2015; Bansi, 2016). This can be attributed to lack of prioritization and inadequate incentives for commercialization among others. Commercialization of research requires provision of infrastructure services such as Technology Transfer Offices (TTOs) and Innovation Incubation Facilities (IIFs).

Figure 3: Cumulative Number of Patents and GDP Growth Rates for COMESA Member States.

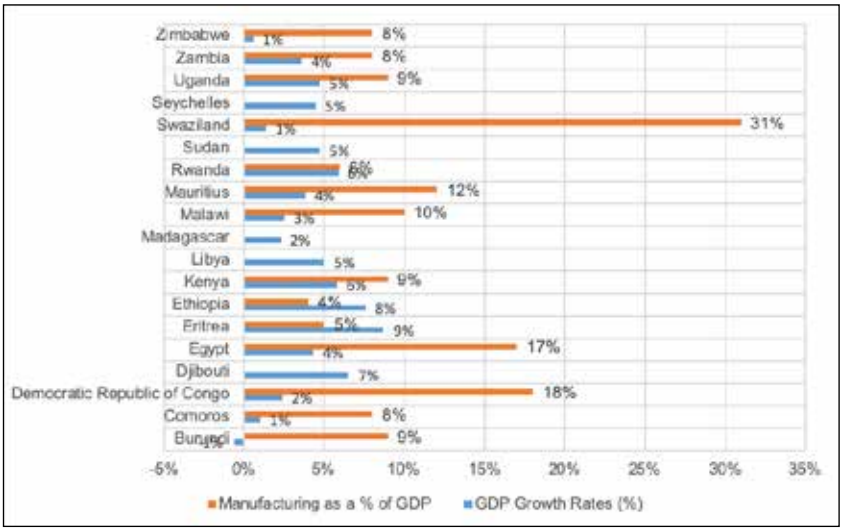


Source: World Intellectual Property Organization and COMESA database 2018

Figure 3 presents the cumulative number of patents and the GDP growth rates of COMESA Member States as at 2016 in constant 2011 prices in US$. The trend reveals some degree of association between the two variables. For instance, countries with many patents like Egypt, Sudan and Kenya seem to experience a relatively higher GDP growth rate.

It is envisaged that the role of the manufacturing sector as stipulated in COMESA Member States' economic policies, is to create employment and wealth through increasing the production and utilization of research and development output. Figure 4 shows the percentage contribution of the manufacturing sector to total GDP in COMESA Member States

Figure 4: Contribution of Manufacturing to Total GDP (%) in COMESA Member States.

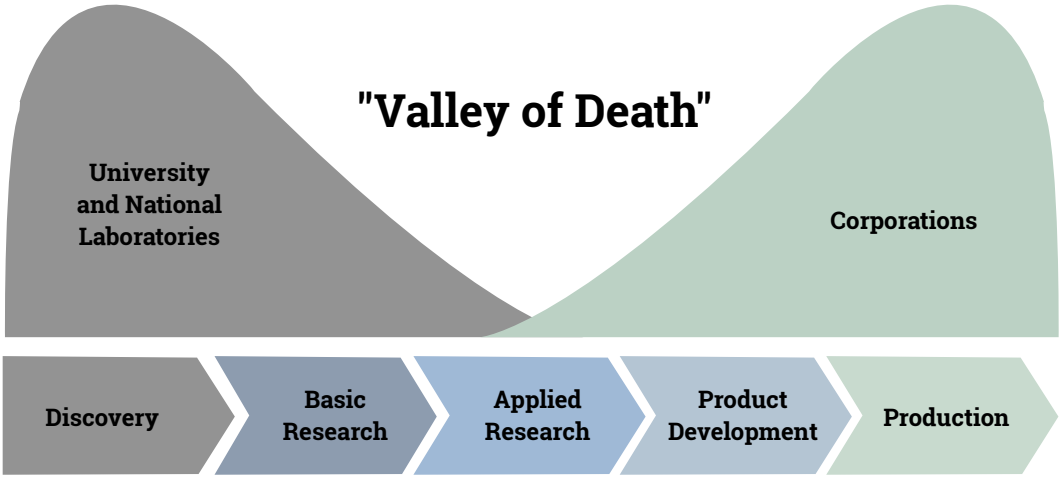


Source: Author's Computation from (World Bank, 2018b)

Figure 4 shows that manufacturing share of GDP ranges from 2 to 31 percent and is a key contributor to GDP. The performance of the manufacturing sector varies among COMESA Member States depending on technological innovations, cost of doing business, access to finance, R&D and availability of managerial, technical and entrepreneurial skills (World Bank, 2018b). Some of the COMESA Member States are among the fastest growing economies in the world; D R Congo, Djibouti, Ethiopia, Kenya, Rwanda and Uganda with growth rates ranging between 5% and 10% in the year 2018. The growth was supported by increased private consumption and investment. On ease of doing business, Mauritius, Rwanda Kenya, Zambia and Seychelles were among the best in Africa in 2018. (World Bank, 2018a). The COMESA region has also focused on strengthening business linkages and intra-regional trade in the COMESA-EAC-SADC[11] tripartite region through the Local Sourcing Project for Partnerships which specifically focuses on training Small and Medium Enterprises (SME) agro-food suppliers.

One of the major weaknesses of the innovation ecosystem in many economies is the existence of the "valley of death". This arises from the realization that a significant proportion of research conducted in institutions of higher learning and laboratories is basic research, and very little is translated into applied research. Majority of the research that is conducted in COMESA Member States universities is basic and is not applied. The economies are therefore starved of high-quality products which could be obtained from the new knowledge. These dynamics are presented in Figure 5.

Figure 5: Accelerating the Transition from Discoveries to Production



Source: Authors' conceptualization

Figure 5 implies that universities and national laboratories among other research institutions and innovation ecosystem partners should play a critical role in applied research to accelerate the transition of discoveries into products that increases employment and economic growth. This will provide COMESA Member States with opportunity to harness the demographic dividend since the youth will churn out the required high productivity jobs, leading to employment creation and growth of the manufacturing sector.

11 EAC stands for East African Community while SADC is Southern Africa Development Community.

1.4 Statement of the Problem

Despite the existence of numerous vibrant universities and research institutes within COMESA Member States, the rate of conversion of research into products has remained low, denying the society the much-needed solutions. This is happening under the backdrop of a shrinking manufacturing sector, which could have otherwise benefited from the commercialization of local research.

Furthermore, COMESA Member States have experienced a bulge in the proportion of young people over the past eight years, with over 70 percent aged below 30 years. With youth unemployment rates still high in these countries, critical questions remain regarding the innovative approaches to address the problem.

This paper uses data from nineteen COMESA countries for the period 2008 to 2017 to build on the existing literature on harnessing of demographic dividends and commercialization of local research relationship in three ways. First, the study demonstrates the link between commercialization of research and increasing manufacturing sector GDP, and the opportunity presented for harnessing the demographic dividend. Second, it separates the economic impact of the two key indicators of public research i.e. the inventive output of universities/Public Research Institutions (PRIs) and commercialization output of universities/PRIs by their TTOs. Third, unlike most previous studies that used samples consisting of developed countries across the world, the study evaluates the same in the African context to ensure that the results are much more specific to this region. This study is motivated by the limited evidence in this significant policy issue which calls for incentivization of the youth to take part in research that translates in to marketable products.

1.5 Study Objectives

The general objective of the study is to examine how commercialization of local research as measured by the number of patents and scientific journals can be used to harness the demographic dividend in COMESA Member States. The specific objectives are to;

i. Determine the contribution of new knowledge and innovation (Patents & Scientific Journals) on Manufacturing Sector GDP.
ii. Evaluate the impact of the total labour force on the capital-intensive Manufacturing sector's GDP.

2.0 REVIEW OF LITERATURE

2.1 Theoretical Review

Several theories exist that show how technology, capital and labour force enter the aggregate economy's production function to explain economic growth. In the Solow's growth model (1956), both labour and effective labour are seen as important variables in generating economic growth. This shows the importance of demographic dividend to economic growth through commercialization of research.

The endogenous growth models are simplified versions of the models of R&D and growth developed by P. M. Romer (1990), Grossman and Helpman (1993) and (Aghion & Howitt, 1992). The model has four variables; labor (L), capital (K), technology (A), and output (Y). The model is set in continuous time and has two sectors; a goods- producing sector where output is produced and an R&D sector where additions to the stock of knowledge are made. A fraction a_L of the labor is used in the R&D sector and fraction (1-a_L) in the goods producing sector. Similarly, fraction a_K of the capital stock is used in R&D and the rest in goods production. Both a_L and a_K are exogenous and constant. Because the use of an idea or a piece of knowledge in one place does not prevent it from being used elsewhere, both sectors use the full stock of knowledge, A.

The quantity of output produced at time t is thus given by:

$$Y(t) = [(1 - a_K)K(t)]^{\alpha}[A(t)(1 - a_L)L(t)]^{(1-\alpha)},$$

$0<\alpha<1$ (1)

The AK model builds on the neoclassical growth model of Solow (1956). Solow (1956)model adopts capital in a broad perspective that excludes human capital from the national income accounts. The AK model emphasizes the importance of human and physical capital as well as innovation levels' contribution to economic growth (Lucas, 1988; Mankiw et al., 1992; P. M. Romer, 1986). Mankiw et al. (1992) defines knowledge as a discernment of how the world works and human capital is used to transfer knowledge to the labour force. Since knowledge does not depreciate, endogenous growth models to assume non- diminishing and constant returns to scale.

Baumol (1990) and Murphy et al. (1991) observed that innovations and advances in knowledge are as a result of the work of talented individuals. They observed that such individuals have choices to pursue innovations and produce goods. These observations suggest that the economic incentives and social forces influencing the activities of highly talented individuals may be important to the accumulation of knowledge. D. Romer (2011) further argues that for individuals to produce goods, they inevitably think of ways of improving the production process. Thus, the accumulation of knowledge occurs as a side effect of conventional economic activity which refers to learning by doing. Analyzing learning-by-doing requires changes to the general endogenous growth model (equation 2) because all inputs are engaged in production of goods. The production function becomes:

$$Y(t) = K(t)^{\alpha}[A(t)L(t)]^{(1-\alpha)} \quad (2)$$

Since the increase in knowledge is a function of the increase in capital, the stock of knowledge is a function of the stock of capital. Thus, there is only one state variable. Making our usual choice of a power function, we have

:

$$A(t) = BK(t)^{\phi}[A(t)L(t)]^{(1-\alpha)} \quad (3)$$

Where B is a shift parameter. As in the Solow model, the saving rate is exogenous and constant

and depreciation is set to zero for simplicity. Thus:

Where B is a shift parameter. As in the Solow model, the saving rate is exogenous and constant and depreciation is set to zero for simplicity. Thus:

$$\dot{K} = sY(t) \qquad (4)$$

Likewise, we continue to treat population growth as exogenous, constant and non-negative for simplicity. This implies:

$$L\dot{(t)} = nL(t)\,, n \geq 0 \qquad (5)$$

Equations 2 and 3, together with equations 4 and 5 describing the accumulation of capital and labor, characterize the economy. To analyze this economy, equation 3 is substituted into equation 2. These yields:

$$Y(t) = K(t)^{\alpha} B^{(1-\alpha)} K(t)^{\oint (1-\alpha)} L(t)^{(1-\alpha)} \qquad (6)$$

Since $\dot{K} = sY(t)$, the dynamics of K are given by:

$$\dot{K} = sB^{(1-\alpha)} K(t)^{\alpha} K(t)^{\oint (1-\alpha)} L(t)^{(1-\alpha)} \qquad (7)$$

If $\oint$ is less than 1, the long-run growth rate of the economy is a function of the rate of population growth, n. If $\oint$ is greater than 1, there is explosive growth. If $\oint$ equals 1, there is explosive growth if n is positive and steady growth if n equals 0. Assuming a steady state growth, the production function (equation 6) becomes:

$$Y(t) = AK(t), \qquad A = B^{(1-\alpha)} L^{(1-\alpha)} \qquad (8)$$

Capital accumulation is therefore given by:

$$\dot{K} = sAK(t) \qquad (9)$$

Equation 9 implies that K grows steadily at rate sA, since output is proportional to K, it also grows at this rate. Thus, long-run growth is endogenous and depends on the saving rate.

2.2 Empirical Review

This section presents several studies that have been done on the role of commercialization of research in harnessing the demographic dividend and promoting economic growth.

Adams (1990) used the count of articles in a number of academic journals to construct a series of 19 industry-specific stocks of scientific knowledge. He used these stocks of publications to explain Total Factor Productivity (TFP) growth in 19 manufacturing industries in the United States (U.S) from 1953 to 1980 and found that publications stocks positively affected TFP growth.

Griliches (1992) reviewed the empirical literature on R&D externalities and found that investments in new knowledge by firms and other organizations not only generate the inputs for innovation for the organization making those investments, but also because of the propensity for knowledge to spill over, for the third-party firms as well. Such externalities are consistent with the basic properties inherent in what Arrow (1962) referred to as information, which is distinct from the traditional factors of production in that it is non- exclusive and non-rivalrous. By serving as a conduit for knowledge spillovers, entrepreneurship is the missing link between investments in new knowledge and economic growth (Audretsch, 2007; Audretsch & Thurik, 2001). Entrepreneurship is an important mechanism permeating the knowledge filter to facilitate the spillover of knowledge and ultimately generate economic growth. The emergence of entrepreneurship policy to promote economic growth is interpreted as an attempt to promote entrepreneurship capital, or the capacity of an economy to generate the start-up and growth of new firms.

Mansfield (1997) used the outcomes of a survey of 76 US firms that had carried out commercial innovations in seven industries to measure the benefits of academic research (within 15 years of the innovation under consideration). By estimating the social rate of return from academic research, he found that ten percent of product and process innovations of these firms could not have been developed without academic research. Using these results, he estimated the social rate of return from academic research and found that it ranged from 20 to 30 percent. He further found that the estimate was a lower bound as it left out the social benefits from other innovations based on the same academic research, accruing to consumers, outside the US and spillovers to firms in and outside the concerned industry.

Guellec and Van Pottelsberghe de la Potterie (2004) carried out a comprehensive analysis of the impact of R&D on Total Factor Productivity (TFP) using a sample of 15 OECD countries from 1980 to 1998.They distinguished between public sector and private R&D. They found that publicly funded research generates a higher degree of spillovers to the economy compared to privately funded R&D. They further found that the responsiveness of TFP to public R&D was higher when private R&D intensity was high. They further found the impact of public sector R&D on TFP growth was positively affected by university R&D and not by other public research institutes.

Vandenbussche et al. (2006) extended the endogenous growth model using a panel dataset covering 19 OECD countries between 1960 and 2000 to examine the contribution of human capital to economy-wide technological improvements. He drew a distinction between the channels of innovations and imitation effects. He found that skilled labor had a higher growth-enhancing effect to the technological frontier.

Audretsch (2007) studied the link between entrepreneurship capital and economic growth, further revealing how and why the Solow growth accounting framework is useful for linking entrepreneurship capital to economic growth. He used a sample consisting of 500 largest U.S. manufacturing over the period 1980 and 1993. The knowledge filter impedes the spillover of knowledge for commercialization, thereby weakening the impact of knowledge investments on economic growth.

Adoyo (2015) examined the factors influencing research outputs of selected universities in

Kenya using the descriptive research design. She found that research output of selected public universities in Kenya was influenced by research funding, industrial involvement, university researchers' characteristics and institutional administrative structures.

Cheah and Yu (2016) analyzed economic impact of research and innovation originating from Public Research Institutions (PRIs) and universities in Singapore by employing a binary logistic regression. The authors applied the R&D-based endogenous growth theory by P. M. Romer (1990) and the Triple Helix by Etzkowitz et al. (2005) to model the flow of knowledge among universities and PRIs, firms and industries, the community and society. They found that firms that incur higher Intellectual Property Licensing (IPL) fees with universities/PRIs had lower propensity to repeat their IPL transactions, thereby reducing academic innovation impact on firms. In addition, firms that got higher levels of RICV with universities/PRIs were found to have higher propensity to repeat their license transactions, indicating an increase in academic innovation impact on firms.

Bansi (2016) investigated the reasons for the current low rate of commercialization of innovations in South African universities using a survey of intellectual property and technology transfer office managers and interviews with individual innovators. He found that lack of support from university management, insufficient incentives for innovators, limited access to funding opportunities, institutional bureaucratic regulations and an inefficient system of decision making on intellectual property were the major factors contributing to low rate of innovations commercialization.

2.4 Overview of Literature

Several studies have been done on the role of commercialization of research in harnessing the demographic dividend (Adoyo, 2015; Bansi, 2016; Cheah & Yu, 2016; Veugelers, 2014). Most of these studies focused on establishing the different factors that influence academic research patenting, the contribution of research to economic growth and some of the challenges that hinder commercialization of research. The studies differ greatly in terms of the aggregated level (company, industry or country), model specification (the explanatory factors included) and how key variables are measured (stocks, flows or changes).

However, these studies did not demonstrate the link between commercialization of research and increasing manufacturing sector GDP, and the opportunity presented by harnessing the demographic dividend. In addition, the studies did not separate the economic impact of the two key indicators of public research i.e. the inventive output of universities/Public Research Institutions (PRIs) and commercialization output of universities/PRIs by their TTOs.

3.0 METHODOLOGY

3.1 Research Design

The study used a non-experimental causal design involving panel data for the period 2010 to 2016 for 19 COMESA Member States. The choice of the starting period was determined by the availability of data for most of the countries. The main sources of data were World Bank Database,

the COMSTAT and the African Development Bank. The data for patents was obtained from World Intellectual Property Organization (WIPO) Database.

3.2 Theoretical Framework

The study was based on the AK endogenous growth model that assumes total output is a function of capital accumulation according to the function below:

$$Y = AK^{1-\alpha} \qquad 0 < \alpha < 1 \qquad (10)$$

The AK model views capital to contain stocks of plant, equipment and knowledge accumulation. As a result, the capital, K in the AK model equation (10) includes both physical and human capital. α represents the output elasticity of capital (returns to scale) and it ranges from 0 to 1. Mankiw et al. (1992) stresses that the assumption of constant returns to scale holds, therefore, such that the production function is linear in capital. This equally denotes that when inputs are doubled, output will double as well. Hence, equation (10) can be rewritten as:

$$Y = AK \qquad (11)$$

Where A represents technology, which is a constant while Y and K are as described before. Thus, the theoretical framework postulates that a country's economic growth is a positive function of both physical and human capital.

Empirical Model

The empirical model is based on the production function (equation 11) with constant returns to scale. The specific panel regression equation estimated is as follows:

$$mgdp_{it} = \beta_0 + \beta_1 labf_{it} + \beta_2 gfcf + \beta_3 joun_{it} + \beta_4 pat_{it} + \beta_5 mob_{it} + \varepsilon_{it} \qquad (12)$$

i = 1,2,.....,19;t = 1,2,.....,9

where $mgdp_{it}$ is the dependent variable represented by the manufacturing sector output/GDP. lab_{it} and $gfcf$ are proxies for total labour force and physical capital while $joun_{it}$ represents the number of Science and Technology Journals. pat_{it} denotes the number of patents and mob_{it} is the number of mobile cellular subscriptions per 100 people. $\varepsilon_{it} = \mu_i + \lambda_t + e_{it}$ is the error term, β_i are the parameters to be estimated while it represents country i in time period t.

The explanatory variables included are: (i) youthful labor force (15 - 35 years) and (ii) gross fixed capital formation as proxies for labour and physical capital respectively; (iii) the number of Science and Technology Journals to measure academic research input; (iv) number of patents, to capture the conception that countries with plenty of patents have managed to harvest the benefits of commercializing research i.e. corporate outcome (Narin et al., 1997) ; and (v) the number of mobile cellular subscriptions per 100 people, to capture the effect of use of mobile phones and social media in general in enhancing the diffusion of research knowledge. Youthful labour force is included as an explanatory variable to address the second objective. Theoretically, the manufacturing sector is known to be capital-intensive hence this paper aims to find out if this is the case in COMESA Member States or if the youthful population as represented by

the proportion of the labour force aged 15 to 35 years of age, plays a role in contributing to the manufacturing sector's GDP. All the explanatory variables are expected to have a positive sign as they are hypothesized to contribute to economic growth.

3.3 Estimation Technique

The static panel specification was estimated using Fixed effects (FE) method. This was after the Hausman test by Hausman (1978) that takes into consideration the assumptions about the error term was conducted in order to make a choice between FE and RE. In a FE model, was assumed to vary non-stochastically over i or t making the FE model analogous to a dummy variable model in one dimension. In a RE model, is assumed to vary stochastically over i or t requiring special treatment of the error variance matrix. FE addresses heterogeneity bias problem, resulting from any correlation that may exist between the regressors and the country-specific effects, by controlling for unobserved effects that are correlated with the error term (Greene, 2012).

3.4 Estimation and Discussion of Results

3.1 Descriptive Statistics

Descriptive characteristics summarize the data for the 19 COMESA Member States for the period 2008 to 2016. The six variables employed in the study include: manufacturing GDP (mgdp), number of patents (pat), number of science and technology journals (joun), gross fixed capital formation (gfcf), youthful labour force (labf), and mobile cellular subscriptions per 100 persons (mob).

The summary statistics of these variables are presented in Table 1 displaying the mean, standard deviation and number of observations of each variable. The results show that the manufacturing GDP averaged 2.35 billion US $ while the number of patents and science & technology journals averaged 65 and 601 respectively.

The manufacturing GDP has a standard deviation of 6.24 billion US $ while the number of patents and science & technology journals have a standard deviation of 180 and 1827 respectively. A large standard deviation implies that the countries in the sample are non-homogeneous and thus there may be issues of convergence of these group of countries.

Table 1: Descriptive Statistics

Variables	Mean	Std. Deviation	Min	Max	Obs
Mgdp	2.35B	6.24B	8.5M	30.7B	171
Pat	64.97	180.38	1	1053	171
journ	600.91	1827.45	0.7	10807	171
Gfcf	21.69	10.54	3.29	45.27	171
Labf	9.89M	11.5M	34,305	42.2M	171
Mob	59.36	42.73	2.02	180.45	171

Source: Author's computation from the study data

4.2 Unit Roots Test Results

Unit roots tests were carried out using Levin-Lin-Chu test and the results are presented in Table 2. The LLC unit root test results showed stationary without a trend at 1% and 5% levels of significance for all the variables.

Table 2: Panel Unit Root Test

Variables	Levin-Lin-Chu (LLC) test		Remarks
	Levels		
	Constant	Trend	
	Statistic	Statistic	
lnmgdp	6.53	-16.68***	Stationary
lnlabf	-5.05***	-18.13***	Stationary
gfcf	-8.94***	-10.15***	Stationary
lnjoun	-4.51***	-12.84***	Stationary
lnpat	-14.22***	-42.87***	Stationary
mob	-6.28***	-6.22***	Stationary

Note: The asterisks * and ** denote levels of significance at 10% and 5% respectively.

lnmgdp, lnlabf, lnjoun and lnpat are logged forms of the variables manufacturing GDP, youthful labour force, science and technology journals and patents respectively.

4.3 Specification Tests

Table 3: Specification Tests' Results.

Specification Test	Null hypothesis	P value
Hausman F-test for FE versus RE models	H_0: RE model is consistent	0.0000
Serial correlation	H_0: No serial correlation	0.0582
Heteroskedasticity	H_0: No heteroskedasticity	0.0000
Cross-sectional dependence Pesaran's CD test	H_0: No cross-sectional dependence	1.1262

Source: Author's Computation using STATA 14

The Hausman's Specification Test of exogeneity of the regressors (no misspecification) versus the alternative of endogeneity of regressors was conducted to choose between FE and RE model. The Hausman test results rejected the RE model hence the study estimated the FE model as shown in Table 3.

In addition, a series of specification tests were carried out to ensure that the classical linear

regression assumptions hold. These include: Wooldridge test for autocorrelation in panel data, the Wald test for group wise heteroskedasticity and Pesaran's test of cross-sectional independence. The specification tests results are shown in Table 3. The results found the problems of heteroskedasticity and autocorrelation which were solved using robust standard errors.

4.4 Discussion of Fixed Effects Regression Results

The fixed effects results are presented in Table 4.

Table 4: Fixed-Effects (within) Regression Results.

Explanatory variables	FE Regression
Youthful labour force	0.0103**
	(2.72)
Science and Technology journals	0.0473
	(0.74)
Gross fixed capital formation	0.0163**
	(2.34)
Number of patents	0.0042
	(0.44)
Mobile cellular subscriptions	0.0020**
	(2.25)
Constant	3.6807
	(0.67)
F test	12.26***
R-Squared	0. 4873
No. of observations	171

Source: Author's Computation using STATA 14

Note: The t statistics are in parenthesis. Levels of significance: *** 1 %, ** 5 % and * 10%.

The first objective of the study was to determine the contribution of new knowledge and innovation (patents & science and technology journals) on manufacturing sector GDP, while the second objective was to evaluate the impact of youthful labour force on COMESA Member States' manufacturing GDP.

The results presented on Table 4 shows a highly significant F-statistic indicating the joint significance of the explanatory variables. Further, the results show the estimated coefficients of all the explanatory variables have the expected signs. The model fits well and explains 49 percent of variations in the manufacturing sector GDP as indicated by the R-squared.

There is a positive and significant relationship between the youthful labour force and

manufacturing sector GDP. A percentage increase in the youthful population is associated with an increase in the manufacturing sector's GDP by 0.01 percent. This implies that the significantly high proportion of youth in COMESA member states contribute significantly to industrial growth and could play a critical role in harnessing demographic dividend. This result is consistent with Vandenbussche et al. (2006) who established that skilled labor had a higher growth-enhancing effect to the technological frontier. The youth should therefore be advocated for to be involved in both public and private research activities conducted in universities and PRIs research that will add to their stock of skills. This will in turn act as an engine for growth in the manufacturing sector through innovation and direct employment into the manufacturing sector. For this to happen more funding is required for the advancement of TVETs and research activities as well as policy advocacy for the private sector to promote research and its output commercialization in the manufacturing sector.

As expected, the coefficient of gross fixed capital formation is positive and significant confirming the heavy reliance of the manufacturing sector on capital. This implies that for every percentage increase in capital investment, the manufacturing sector's GDP improves by 0.02 percent.

The study further found a positive relationship between mobile cellular subscriptions and the manufacturing sector GDP. The result indicates that an increase in mobile cellular subscriptions by one percent increases manufacturing sector GDP by 0.02 percent. This confirms the increased use of technology in diffusing academic research and knowledge. Mobile phones have played a key role in sharing of information including scientific publications thus contributing positively to research work commercialization by the manufacturing sector.

5.0 Conclusion and Policy Implications

The main motivation for the study was to examine how commercialization of local research as measured by the number of patents and scientific journals can be used to harness the demographic dividend in COMESA Member States. The study employed the Fixed effects method to examine the impact of the number of patents and scientific journals on manufacturing GDP. FE estimation technique is preferred so as to addresses heterogeneity bias problem, resulting from any correlation that may exist between the regressors and the country-specific effects .

The results from the FE analysis show that the youthful labour force, capital and mobile cellular subscriptions are important factors in generating growth in manufacturing sector output in COMESA Member States. The young population is expected to gain by undertaking research and participating in its commercialization in the manufacturing sector. Access to mobile phones and ICT services plays a key role in sharing academic knowledge and research outputs with the manufacturers.

These findings are consistent with results from other studies such as Mansfield (1997) and Vandenbussche et al. (2006) who established a positive association between scientific research and firms' performance.

The study recommends that COMESA should:

i. Support provision of quality tertiary education that contextualizes research, innovation and entrepreneurship.
ii. Encourage the culture of commercialization of research output.
iii. Incentivize the youth to take part in academic research that translates into commercialization of research output.
iv. Enhance/increase research funding and set up incubation centers to facilitate incubation and commercialization of innovative research outputs.
v. Strengthen the innovation ecosystem by developing and implementing policies to ensure that intellectual property management system is robust and properly incentivized.

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Assessment of the Entrepreneurial Intent for Technology Businesses by Technical and Vocational Education and Training (TVET) Students in Kenya

Juliana Mbithi * Karanja Mwangi **

Abstract

The study assessed the entrepreneurial intent for technology (tech) business by Technical and Vocational Education and Training (TVET) students in Kenya and perceived barriers towards tech entrepreneurship. A sample of 500 TVET students was interviewed via online questionnaires. The study adopted a positivist approach, and the Pearson's product moment correlation coefficient (r) to determine the relationship among variables of interest. The Principal Component Analysis (PCA) approach was used to group perceived barriers to entrepreneurship among TVET students. From the results, TVET students have a positive attitude towards tech entrepreneurship and entrepreneurship education. Further, lack of access to funds, inappropriate entrepreneurship education/teaching methods and government regulations and policies are the highest barriers to the entrepreneurial intent for tech business among TVET students in Kenya. The study recommends the creation of an enabling environment in TVETs to nurture skills of students by investing more on ICT in TVET institutions, establishment of TVET-linked innovation hubs that will nurture tech business ideas of TVET students, training TVET students' in entrepreneurial skills and mentoring and supporting them.

Introduction

1.1. Background

The youth population in Africa is rapidly increasing and is expected to double to over 830 million by 2050 (AfDB, 2016). Thus, global, regional and national development agenda are geared towards empowering the youth as they are considered the engine of development. The sustainable development goal (SDG) number eight seeks to achieve full and productive employment and decent work for everyone, including for youth and persons with disabilities by 2030. It also seeks to significantly reduce the proportion of unemployed youth, intensify education and training, and develop and operationalize a global youth employment strategy by 2020. It also aims at implementing the ILO Global Jobs Pact (ILO, 2015).

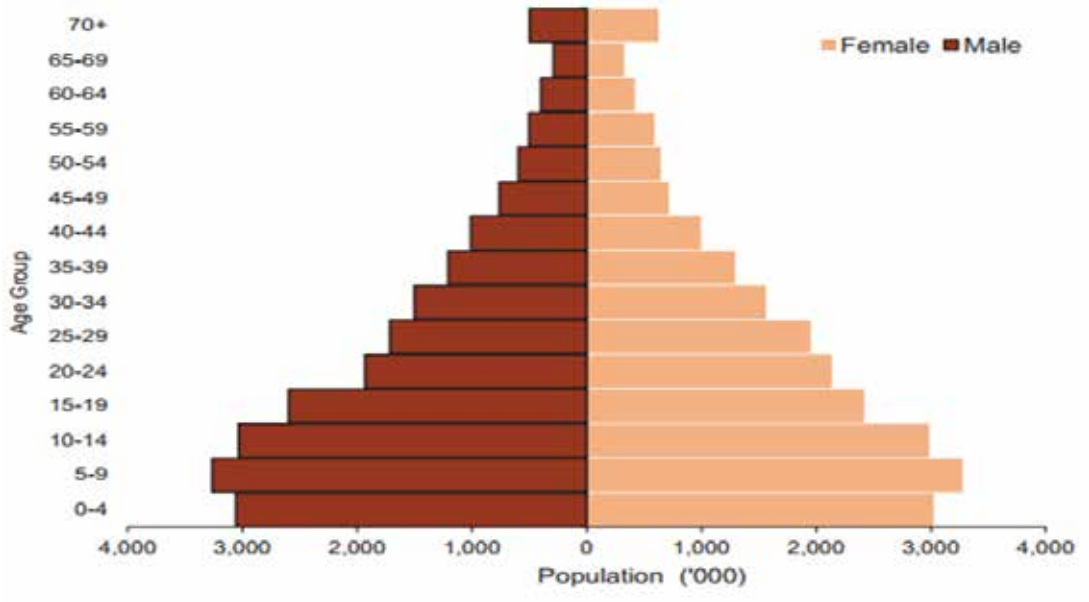
Similarly, Goals four and five of the African Union (AU) Agenda 2063 envisions an engaged and empowered youth workforce, which is to be achieved through education and revolution of skills driven by science, technology and innovation (AU, 2015).,

Further, the Kenya Vision 2030 outlines youth flagship projects that will ensure full integration and harmonization of issues affecting the youth into public policies and programmes. Key among these include the affirmative action policy, revision of education and training curriculum, increment in bursary allocation for secondary and tertiary level, revitalisation of youth polytechnics, establishment of the Youth Enterprise Development Fund and Youth Empowerment Centre among others. The Big Four agenda also focuses on creation of employment, more so for the youth, through expansion and revitalization of the manufacturing sector. The government targets improving the TVET so as to equip graduates with the requisite skills to drive industrialization.

According to Schramm (2006), entrepreneurship is a major contributor to economic growth and development since it is a driving force for innovation and invention. Increased international competition based on creativity, agility and innovation has led to increased interest in entrepreneurship (Lüthje and Franke, 2003). Moreover, self-employment is linked to desirable work values including independence, self-realization and challenge.

The Kenyan population is largely comprised of the youth and children (0-34 years) as illustrated in figure 1. This explains why the government is putting much efforts towards engaging this population in productive activities. The Kenya Integrated Household and Budget Survey of 2015-16 revealed that 85 per cent of the unemployed comprise the youth.

Figure 1: Kenya Population Pyramid, 2016



Source: KNBS, 2018

According to Chinamasa (2014), implementation of programs geared towards youth empowerment and support for small and medium enterprises (SMEs) has included vocational training of youth as a key element. In Kenya, the government has recognized Technical Vocational Education and Training (TVET) as a key player in the reduction of youth unemployment. The government is already putting efforts towards revamping TVET as enshrined in the Constitution of Kenya 2010, TVET Act of 2013, establishment of a Permanent Working Group (PWG) on TVET in 2014 and the increment in TVET budget from Sh6 billion in 2017/18 to Sh16 billion in 2018/19 financial year. The Constitution provides for devolution of TVET thus presenting a great opportunity for the expansion and improvement of the institutes across the 47 counties. Further, the TVET Act of 2013 aims at reducing skills mismatch and inadequacy by ensuring majority of youth that transition to the labour market have the relevant skills. A specific objective of the act is to increase and sustain TVET enrolment ratio of 30 per cent by 2030, which is more than double the current ratio (11.6% tertiary enrolment ratio as at 2016). The PWG's key mandate is to promote collaborations between TVET and the industry, and to guide the implementation of TVET reforms in Kenya. However, the sector is faced with challenges of low enrolments, inadequate financing and curriculum alignment to match global manufacturing trends.

1.2. Digital Dividends

Digital dividends, defined as development benefits that arise from using digital technologies (World Bank, 2016), can promote inclusive growth and development if well tapped. Digital technologies have been known to promote efficiency, innovation and inclusion. An example of where such benefits have been harnessed is in the technology or innovation hubs space. This is

where several startups have been launched and are a major source of employment.

Technology hubs, commonly known as tech hubs are working spaces and/or communities with shared interest in moulding a digital entrepreneurship ecosystem through incubation mentorship and ideas acceleration (Jiménez & Zheng, 2018). Tech hubs, accelerator and incubator entities, and co-working spaces in Africa have grown tremendously in recent years owing to their ability to bring tech business to the grassroots. Promotion of entrepreneurship and innovation by tech hubs has attracted attention from international organizations and venture capitalists among other relevant actors.

As at 2016, Africa had 314 active tech hubs (Du Boucher, 2016). In Kenya, some of the hubs that have taken off include; iHub, NailLab, m:Lab, Ushahidi, and Strathmore based iBiz and iLab . iHub, has been the most successful, having led to the establishment of over 200 start-ups in the country with the most popular and successful ones being Ma3route and Mfarm. Notably, Kenyan tech space has made a significant milestone following devolution, as new tech hubs are developing outside Nairobi, which is known as the country's "Silicon Savannah". Examples include SwahiliBox (Mombasa), LakeHub (Kisumu), Dlab Hub (Eldoret), Sote Hub (Voi), Ubunifu (Machakos), and Mt. Kenya Hub and DeHub (Nyeri).

De Beer, Millar, Mwangi, Nzomo, & Rutenberg, (2016), have identified a framework for assessing success factors in technology hubs with case studies from Kenya, terming them as important drivers of technological innovation, economic opportunity and social transformation. Kenya's Vision 2030 recognizes technology incubation centres as one of the contributors of achieving its goals, due to their potential to tap the demographic dividend.

1.2.1 Technology as Curriculum in TVET

Technology as part of TVET curriculum involves the development of ICT literacy skills, such as generic ICT literacy skills (word-processing, keyboarding, use of databases spreadsheets and Internet); and occupation- specific ICT literacy skills (the ability to use computer numerical control (CNC) equipment, operate equipment with digital system controls and work with Computer-aided design and Computer-aided manufacturing (Kasworm and Londoner, 2000).

1.2.2 Using lCT for Informal Skills Development

According to the Kenya National Bureau of Statistics (KNBS) basic labour force survey 2015-16, most of the new jobs in Kenya were created in the informal sector. For instance, out of the 897,800 jobs generated in 2017, over 700,000 were in the informal sector. As Singh (2000) notes, in addition to the technical skills that graduates from TVETs possess; workers must also have some generic competencies in entrepreneurial, cognitive and social skills.

1.3. Increased Technology Usage and Youth Unemployment

Despite the notable contribution of technology towards inclusive growth, youth unemployment in Kenya remains a challenge. According to the Kenya Integrated Household Budget Survey (KIHBS) 2015-16[12] labour force basic report, the total unemployment rate was 7.4 per cent, with youth constituting about 85 per cent of the unemployed (KNBS, 2018). Of the total youthful working age population in Kenya, about 37.1 per cent are unemployed (Kamau, Kinyanjui, Akinyoade, & Mukoko, 2018). Despite the Kenyan government launching various initiatives geared towards lowering the high rate of youth unemployment, labour demand continues to fall short of supply. It is estimated that over one million youth enter the labour market without the basic skills (Kaane, 2014). Such population end up in informal employment, characterized by low productivity and poor income (Kaane, 2014). In recent years, Kenya has implemented initiatives to address youth unemployment such as the Youth Enterprise Development Fund, Women Enterprise Fund, Uwezo Fund, the National Youth Service and Kazi kwa Vijana among others. However, youth unemployment in the country continues to soar.

1.4. Structure of TVETs in Kenya

UNESCO (2015) defines Technical and Vocational Education and Training (TVET) as education, training and skills development activities that relate to occupational fields, production and livelihoods. In Kenya, TVET entails all the vocational and technical training institutions. The current structure constitutes of two national polytechnics, one technical training college, 55 technical and vocational colleges, and 816 youth polytechnics as shown in table 1

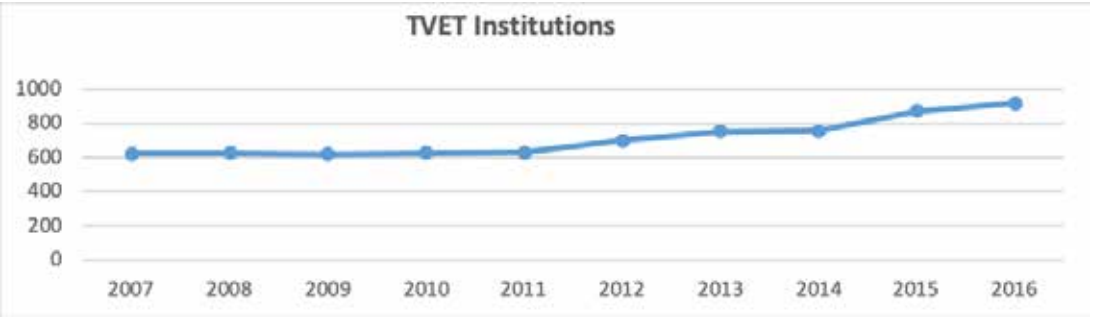
Table 1: Number of TVET Institutions by Category before and after the Reforms

Year	Youth Polytechnics	Technical and vocational colleges	National Polytechnics	Polytechnic University Colleges	Total TVET
2007	574	45	4		623
2008	576	47	4		627
2009	579	36	2	2	619
2010	582	40	2	2	626
2011	585	40	2	2	629
2012	647	49	3	2	701
2013	701	49	3		753
2014	701	51	3		755
2015	816	55	3		874
2016	845	62	11		918

The number of TVET institutions has increased significantly from 2011 as shown in Figure 2, following the introduction of reforms that led to expansion of TVET and implementation of the TVET Act 2012. This Act stipulates that all TVET institutions must register with the Technical Vocational Education and Training Authority (TVETA).

12 https://www.knbs.or.ke/overview-of-census-2009/?cp_2009-population-and-housing-census=2

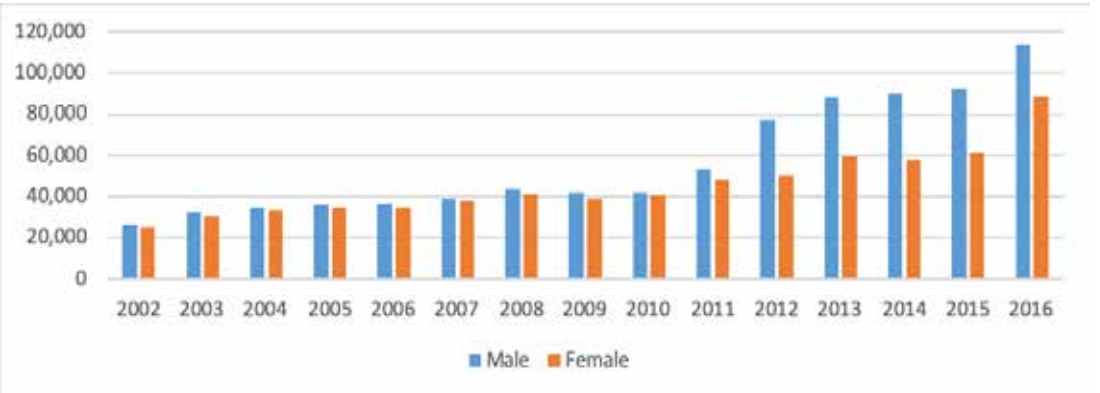
Figure 2: Total Number of TVET Institutions before and after Introduction of the Reforms



Source: KNBS (2012, 2016)

In terms of enrolment, TVET has recorded a gradual increase from 2003 to 2008 as shown in Figure 3. The decline in enrolment in 2009 was due to upgrading of two polytechnics (Kenya Polytechnic and Mombasa Polytechnic) to university college status. There is however, a significant rise from 2011 onwards due to increment in the 2010-2011 budget that saw 14 institutes of science and technology allocated KSh560 million to upgrade their facilities (Gachie, 2013). Further growth in TVET enrolment can be attributed to the onset of TVET reforms in 2012, with the most significant being the enactment of TVET Act, 2013.

Figure 3: Enrolment Trend in TVET (2002-2016)



Source: KNBS (2016)

Despite the growth in the TVET, the sector faces various challenges that hinder provision of adequate skills required in the labour market. Such challenges include; low enrolment, poor perception, inadequate financing and understaffing.

1.5. Problem Statement

Skills mismatch has been frequently cited as one of the major challenges that plaque the Kenyan labour market. A specific focus on young people who constitute the biggest proportion of Kenya's population has revealed that they also constitute the largest proportion of the unemployed (85%). This high unemployment rate has been partially linked to the mismatch between workforce skills and new employment opportunities. The government of Kenya continues to invest in education and training with the goal of creating an enabled workforce, which is critical in achieving the country's Vision 2030. Part of the government's agenda has been to revamp the TVET sector as it holds the key to building the technical and entrepreneurial workforce.

However, education and training on Tech entrepreneurship, innovation and incubation, which are requisite for workforce given the recent technological advancement, has mainly focused on university graduates localized urbanite or peri-urban populations in Kenya, while neglecting TVET. As a result, majority of TVET graduates lack necessary or adequate skills to fit the technologically advanced labour market needs or venture into entrepreneurship. If not addressed urgently, the skills gap could exacerbate the current youth unemployment rates and limit the economy's growth. Provision of the necessary skills requires determination of the skills gap, which entails assessing the industry demand and the supply side intent. Given the technological advancement, and the role played by self-employment in driving the economy, there is need to understand the perception of tech entrepreneurship among potential labour market entrants.

1.6 Study Objectives

This study sought to assess the entrepreneurial intent for tech businesses by TVET students in Kenya. Specifically, the study assessed:

i. Attitude towards tech entrepreneurship among TVET students in Kenya;
ii. TVET student' attitude towards entrepreneurship education; and
iii. Perceived barriers to tech entrepreneurship by TVET students in Kenya.

2.0 REVIEW of the LITERATURE

This section presents the theoretical and empirical literature review.

2.1 Theoretical Review of Literature

Entrepreneurial intent refers to the willingness of an individual to engage in an entrepreneurial behaviour or action, establish a new business or be self-employed.

Entrepreneurship intention is a precursor for individual to initiate a business. It is a measure of individual perception in their ability to act as an entrepreneur (Al-Harrasi & Al-Salti, 2014). The decision to start a business requires planning and cognitive engagement which can be analysed using intention models and theories. Theory of Planned Behaviour and Shapero's entrepreneurial

event model offers constructs to deduce planned behaviour.

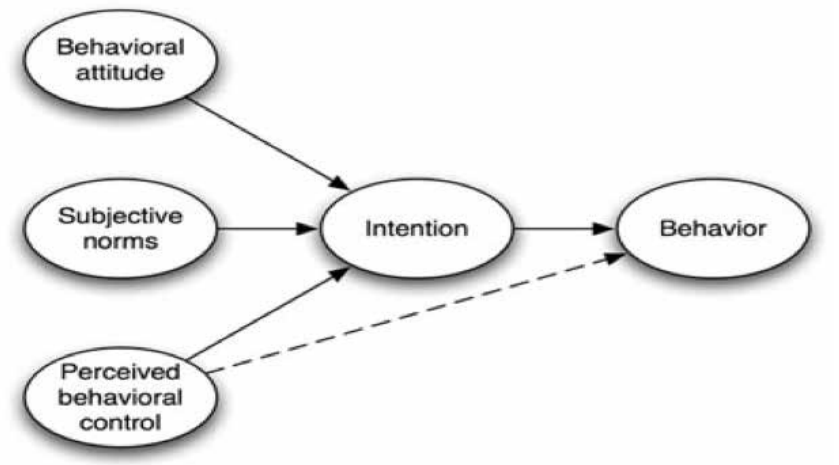
2.1.1 Social Networking Theory

Social networks theory postulates that persons may get information and knowledge which they did not have from their circle of partnerships or friends thus exposing them to new ideas in business (Singh, Hills, Hybels, & Lumpkin, 1999; Singh Sandhu, Fahmi Sidique, & Riaz, 2011). The model does not cater for physchological charactersitics such as perception and indvividual view towards entreprenuership which are key in determining the nature and extent of entreprenuership intent (Ariff, Husna, Bidin, Sharif, & Ahmad, 2010; Venesaar, Kolbre, & Piliste, 2006).

2.1.2 Theory of Planned Behavior

Human being attitude towards a given behaviour known as subjective norm-influenced by social validation and perceived behavioural control results to intention as shown in Figure 4.

Figure 4: Theory of Planned Behaviour



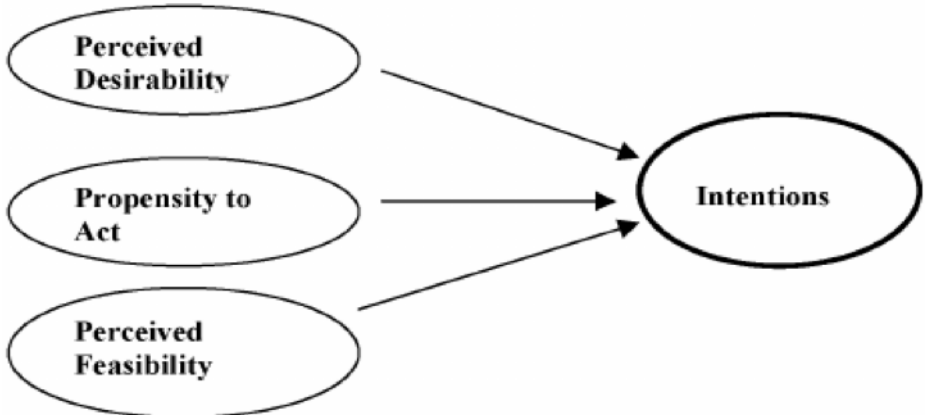
As shown in Figure 4, subjective norms are the social influences with group dynamics that influence the participant to engage in a certain activity or not. Business mentors, social role models and family support have been identified in literature as key sources of these norms (Mat, Maat, & Mohd, 2015; Moriano, Gorgievski, Laguna, Stephan, & Zarafshani, 2012).

Behavioural attitude refers to individual ratings or appraisal that given actions will be favourable or not. In entrepreneur sense, it is the attitude towards a desire to start a business.

2.1.3 Shapero's Model of Entrepreneurial Event

Shapero (1982) suggests that entrepreneurial intentions depend on perceptions of personal desirability (personal attractiveness to start a business), feasibility (the degree to which one feels capable of starting a business) and personal mood to act on one's decisions as shown in Figure 5.

Figure 5: Shapero's Model of Entrepreneurial Event



The model has overlapping concepts with Theory of planned behaviour. The difference between the two is that Shapero's model elucidates more on personal factors and capability to execute a behaviour (Katundu & Gabagambi, 2016; Tiago, Faria, de Almeida Couto, & Tiago, 2014).

2.2 Empirical Review of Literature

2.2..1 Technology and Entrepreneurship

Literature on tech entrepreneurship is limited given that the concept is relatively new. Sambuli and Whitt (2017) analyzed how digital investments interact with analog complements, via tech hubs across Africa, and success factors in terms of creating tech start ups. Findings revealed existence of different categories of tech hubs: those that are either incubators, accelerators or both (e.g. Nailab, iSpace, iBizAfrica, m:lab East Africa). The study also identified various ways through which tech hubs engage with policy makers: Indirect or non-engagement, superficial engagement, strategic engagement and client-based engagement.

Kelly and Firestone (2016) examined 117 tech hubs in Africa, through interviews and desktop reviews. They found out that despite the rapid spreading of digital technologies, digital dividends have not spread proportionately. The study further found that realization of digital dividends requires improvement of the analog complements to digital investments.

World Bank (2014) evaluated mLabs and mHubs outcomes and entrepreneurial success stories in Sub-Saharan Africa, East and Central Asia and Eastern Europe. The study selected case studies from the above regions, which included mLab East Africa (Kenya), Mobile Monday Kampala (mHub Uganda) mLab Southern Africa (South Africa), mLab East Asia (Vietnam), mLab ECA (Armenia); mLab South Asia (Pakistan), Mobile Nepal (mHub Nepal), and Akirachix (mHub Kenya). The study found thatmLabs and mHubs have generated a positive and significant impact on entrepreneurship ecosystems in which they operate such as: mobile innovation, improved linkages between stakeholders and creation of an enabling environment to spur creation of startups. Further, the study found that mobile apps developed by entrepreneurs supported by mLabs improved areas such as education, financial inclusion, healthcare, transport, environment and governance.

2.2.2 Entrepreneurial Intent

Lüthje and Franke (2003) tested entrepreneurial intent among a sample of 512 engineering students of the Institute of Technology and Innovation Management in Germany. Using a covariance structure model the study found that personality traits have a strong impact on students' attitude towards self–employment, with entrepreneurial attitude being strongly linked to one's intention to begin a new venture. The study further found that the students' entrepreneurial intent was directly affected by perceived barriers and entrepreneurship support factors such as entrepreneurial education and training in colleges.

Yilmaz (2013) examined the influence of humanistic values towards preference of entrepreneurship. The study adopted a qualitative method and random sampling to collect data from 482 students at Selçuk University, and a relational screening model for analysis. The study found a significant relationship between humanistic values and entrepreneurship tendency. Mkala and Wanjau (2013) examined factors that influence the implementation of entrepreneurship education programme in tertiary technical institutions in Kenya. Using a sample of 58 teachers of technical institutions in Nairobi County, the study found that teaching methods influence implementation of TVET programmes. Marire, Mafini and Dhurup, (2017) examined the influence of personal attitude, perceived behavioural control, subjective norms and entrepreneurship education on entrepreneurial intentions amongst Generation Y students in Zimbabwe. Using a sample of 200 students and the structural equation modelling procedure, the study found that personal attitudes, entrepreneurship education and perceived behavioural control influence entrepreneurship intentions.

2.3 Overview of Literature

Among the studies reviewed, various models such as the covariance structure model, relational screening model and structural equation modelling are used to establish how the various aspects interact. These studies however overlook the theory of Planned Behavior and

Shapero's entrepreneurial event model, which provides a theoretical basis of the determinants of entrepreneurial intentions. This study, therefore, conceptualises a framework informed by Shapero's theory and focuses on TVET students.

3.0 Methodology

3.1 Research Design

The study adopted a positivist approach which refers to the view that the only authentic knowledge is scientific knowledge which come from positive affirmation of theories through a scientific method such as data analysis.

A qualitative approach was adopted. The study employed an online questionnaire for data collection. TVET students were asked questions on key perceived barriers to engage in technology entrepreneurship.

The study used a sample of 500 students selected from TVET colleges in Kenya. RASOFT package was used to calculate the sample size. From RASOFT a marginal error that is tolerable is estimated to be 4.41 per cent , using confidence level of 90 per cent and the expected distribution of 87 (Rasoft, 2004). Simple random sampling was used where each subject had equal chances of being selected from the population.

3.2 Test Statistics

Pearson's product moment correlation coefficient (r) was used to determine the strength of the relationship and T- Statistic Test was used to compare the mean scores of men and women on their perception towards entrepreneurship. Principal Component Analysis(PCA) was used to group perceived barriers. PCA is a multivariate statistical method which determines the variability among compared observed variables (Makgosa & Ongori, 2012; Tanveer et al., 2011). Table 2 shows a summary of various constructs that leads to the conceptual framework and their empirical validation sources.

Table 2: Summary of various variables

Variable	Measurement
Perceived Behavioural control	Perceived Barriers to tech entrepreneurship
Attitude Towards behaviour	Attitude towards tech entrepreneurship
Entrepreneurial Intention	Initiative expectations and the desire to start a tech business

4.0 Study Findings and Discussion of the Results

4.1 Demographic Characteristics

Out of the 500 sampled students, 100 responded, translating to a response rate of 20 per cent. This low rate is attributed to the mode of interview used, which was online questionnaires. Among the 100 respondents who participated, there were 54 males and 45 females. Only one respondent did not indicate his/her gender.

4.2 Respondent's Entrepreneurial Intent for Tech Business

Table 3 shows the respondents entrepreneurial intent scores. The results show that 75 per cent of the respondents have a vision and professional goals to become tech entrepreneurs. 61 per cent of the respondents wish to start their own tech business in the next two to three years while 58 per cent have a strong intention to start tech businesses upon completion of their studies. Further, 57 per cent of the respondents are prepared to start their own tech business and generally, the intent to pursue entrepreneurship in tech businesses is high with an average of 3.92 out of a possible five.

Table 3: Respondents Entrepreneurial Intent for Tech Business

Statements	Strongly Agree	Agree	Neutral	Dis-agree	Strongly Disagree	Mean	Std. De-viation
My vision and profes-sional goal is to be-come an entrepreneur.	53	21	10	6	3	4.27	1.089
I am prepared to do anything to start my own business.	33	28	19	7	6	3.85	1.191
I will start my own business in the next 2-5 years' time.	30	24	26	7	7	3.85	1.215
I intend to start a busi-ness after I complete my studies.	34	26	23	5	6	3.71	1.206
Average						3.92	1.175

4.3 Barriers to Tech Entrepreneurship

Table 4 shows a summary of the perceived barriers to tech entrepreneurship by TVET students in Kenya. The following were found to be the major barriers to tech entrepreneurship: fear of failure, lack of personal savings, insufficient skills to run a business, difficulty to write a business plan, costly process of registering a business and complex documentation procedures for business registration.

Table 4: Barriers to Tech Entrepreneurship

Statements	N	Mean	Std. Deviation
I have fear to start a business because of uncertainty of the future	96	2.40	1.443
I have fear of failure	99	4.06	1.209
I have fear of competition.	94	2.67	1.390
I have fear that I will be in debts	93	2.62	1.347
I don't have personal savings	99	3.39	1.478
It is difficult for graduates to obtain a bank loan to start a new business	92	3.69	1.355
I don't have collateral security required to obtain bank loan	91	3.84	1.344
The process of registering a business is costly.	98	3.31	1.289
The documentation procedures for business registration are complex	98	2.97	1.401
It is difficult to obtain a trading licence.	96	3.08	1.125
I can't write a business plan.	98	3.30	1.309
I have not learnt and gained enough skills of running a business.	99	3.37	1.117
There are no incubators for graduates to create & grow their business.	93	3.15	1.509
Information about financial institutions that can assist in funding is not readily available to students	91	2.72	1.434
It is difficult to obtain government grants to start a business.	94	2.39	1.371
I don't have support from family and friends to start a business.	96	2.69	1.387
Entrepreneurship education offered in my college does not provide enough attention to learning practical skills.	94	2.94	1.456

Table 5 shows that the Kaiser-Meyer-Oklin value was 0.790, exceeding the recommended value of 0.6. The Bartlett's Test of Sphericity indicated statistical significance hence we factored the correlation matrix. From the reduced matrix, perceived lack of access to funds, inappropriate entrepreneurship education/teaching methods and government regulations and policies were the highest barriers to tech entrepreneurial intention.

Table 5: KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.790
Bartlett's Test of Sphericity	Approx. Chi-Square	1346.241
	Df	78
	Sig.	.000

Independent Sample T- statistic Test was used to determine whether there is a difference in perception between men and women on the perceived barriers to tech entrepreneurship intentions. Table 6 shows that the T-statistic was not significant for any of the factors, implying that there is no difference in perception between male and female TVET students on the perceived barriers to tech entrepreneurship intentions.

Table 6: Independent T-tests

Factor	**t-test for Equality of Means**		
	T	**D.f.**	**Sig. (2-tailed)**
Fear of to start a tech business	-0.707	95	0.406
Lack of access to funds	1.267	95	0.209
Government regulations & policies	-1.002	95	0.319
Inappropriate Entrepreneurship education (EE)/Teaching methods	-0.151	95	0.881
Entrepreneurial support	-0.25	95	0.803

5.0 Conclusion and Policy Implications

4.1 Conclusion

Digital dividends, if effectively tapped, leads to improvement in the capacity of individuals to perform tasks. The study examined the tech entrepreneurship intention of TVET students in Kenya using a Likert scale approach. Results have showed that TVET students have positive attitude towards tech entrepreneurship and entrepreneurship education. However, if TVET students lack entrepreneurial support either from government, family and friends, they are

likely to have lower entrepreneurial intention and vice versa.

4.2 Policy Implications

Based on the study findings that TVET students have positive attitude towards technology entrepreneurship, there is need for the national and county governments to create an enabling environment in TVETs to nurture their skills. This would entail:

- Investing more on ICT in TVET institutions;
- Establishing TVET-linked innovation hubs that will nurture business ideas of TVET students;
- Implementing competency-based curriculum for TVET that entails more entrepreneurial skills training;
- Inculcating entrepreneurship skills based on market best practices to various categories of trainees in the vocational training; and
- Mentoring and supporting the students in the entrepreneurship aspirations by family, friends, private sector and trainers.

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