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A quantitative analysis on the potential impact of blue economy on developing countries' economies: the case of Kenya

Willie M. S Andriamahazomandimby

WORLD MARITIME UNIVERSITY

Malmö, Sweden

A QUANTITATIVE ANALYSIS ON THE POTENTIAL IMPACT OF BLUE ECONOMY ON DEVELOPING COUNTRIES' ECONOMIES (THE CASE OF KENYA)

By

WILLIE M. S. ANDRIAMAHAZOMANDIMBY

Madagascar

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DECLARATION

I certify that all the materials in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me. The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

Signature:

Date: 24th September 2019

Supervised by: Johan Hollander (Ph. D.)

Supervisor's affiliation: Professor in Sustainable Marine Management and Ocean Governance

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ABSTRACT

Title of Dissertation:	**A quantitative analysis of the potential impact of blue economy on developing countries' economies (The case of Kenya)**
Degree:	**Master of Science**

The dissertation studied the potential impact of blue economy on developing countries' economies as a tool to guide public policies oriented to economic growth. In fact, some economic activities might be developed at the expense of the environment. Developing countries' economies face dilemma in which they need the use of natural resources to escape from poverty while needing to protect the environment to ensure the sustainability of the economic growth. This paper tries to address such matters by finding the drivers of economic growth from four identified sectors (energy, tourism, fishery and shipping), then discussing the potential risks related to the development of the sectors and giving some recommendations on how to minimize the effects on the environment while still ensuring economic growth. Quantitative data was collected from diverse sources like KNBS, Kenya Central bank, KTB, and Unctad. From the data a model was built using Eviews to identify the drivers of the GDP. The findings highlight that energy, tourism and shipping are the areas to exploit in order to get economic growth. As the model was not fit for a forecast, an interpretation of coefficients was done to orient the discussion, followed by some recommendations on practices to keep and new measures to adopt to ensure both sustainability and economic growth in Kenya.

KEY WORDS: Blue economy, economic growth, sustainability, Kenya.

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LIST OF ABREVIATIONS

ADF	Augmented Dickey-Fuller
ARMA	Autoregressive and moving average
BLUE	Best linear unbiased estimator
ECI	Environmental condition indicator
GDP	Gross domestic product
KNBS	Kenya National Bureau of Statistics
KPLC	Kenya Power and Lighting company
KPSS	Kwiatkowski-Phillips-Schmidt-Shin
KTB	Kenya Tourism Board
MPI	Management performance indicator
MTCC	Maritime Technology Cooperation Centre
OPI	Operational performance indicator
PP	Phillips-Perron
SD	Standard deviation
TBT	Tributyltin

1 INTRODUCTION

1.1 Background

Apart from being the world's biggest carbon sink, ocean provides us with goods and services for free including water cycle, food security, routes for shipping, recreational areas, mining opportunities and more. (Mary, 2018). Also, ocean gives us 50% of the oxygen we breathe. (CGTN, 2018). However humans, while trying to supplant the nature, ended up wasting natural resources resulting in exhausting the Earth. (Pauli, 2018).

To lessen damages caused to nature, and mainly to the seas, the whole world has agreed to come and discuss about preserving the ocean while still achieving growth in November 2018. The first conference on blue economy was held in Nairobi, Kenya to find solutions on combating poverty by 2030 while focusing on sustainable development.

Countries with high dependency on maritime activities have already put in practice strategies aiming for blue growth while preserving the marine life like Singapore where in 2015, corals were relocated before the construction of the new container terminal could begin (MPA, 2016). Some other countries, however, especially developing countries alongside the East African coast (Somalia, Kenya, Tanzania) are privileged as the area is reported less damaged in terms of ecosystems and habitats. The zone's coral reefs were reported "unusually healthy" in 2016 because of the reduced human activity effects that they have to bear (Karen, 2016). This constitutes a high potential to exploit in terms of blue growth since coral reefs are rich in biodiversity, offering huge opportunities for fisheries and aquaculture. Many activities related to the maritime sector could then be developed in any of the countries of that eastern African coast such as sustainable fishery, tourism, energy and, shipping. In my case, I have chosen the case of Kenya for the country is determined to get involve in promoting the ocean economy through the different policies to preserve the environment so that sustainability can be ensured.

1.1.1 Fishery

In Kenya, the fishery sector employs more than two million people through diverse activities from fish distribution to gear and craft repair services. Also, fishery plays an important role in Kenya as it provides the local population with food and ensures stable income for fishermen and exporters.

Economically speaking, the contribution of fishing to the national revenue is estimated around $900 million USD with its potential production of 350 000 metric tonnes per year. (Capitalbusiness, 2018). That is a high potential for the economy awaiting to be exploited smartly to sustain economic growth as the catch seems to follow the population growth like it is shown in figure 1. In that pace, sustainability might not be assured if policies are not adjusted.

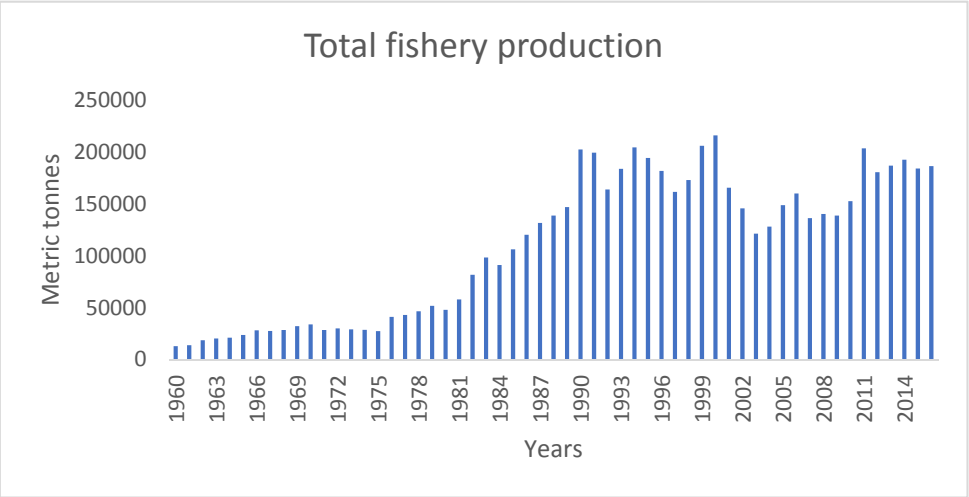

FIGURE 1-CAPTURE FACTS 1960-2016 (WORLD BANK, 2016).

THERE IS CONSIDERABLE INCREASE OF THE CATCH FROM THE EARLY 1980S, AND THE LEVEL OF HARVEST REMAINS HIGH UNTIL 2014, WHICH MATCHES THE HIGH GROWTH OF POPULATION WHICH WENT FROM SIXTEEN MILLION IN 1980 TO FORTY-ONE MILLION BY 2010.

1.1.2 Tourism

According to OECD, more than 75% of vacations are spent on coastal cities all around the World. Added to that cruise ships have a non-negligible place in the leisure industry. (OECD, 2017). This is to highlight the importance of the sea in the tourism sector.

In the case of Kenya, the ocean economy of the country is constituted at 90% by tourism (David, 2017). People come to Kenya to visit many places including its coastal cities and to do recreational fishing (Capitalbusiness, 2018), which has allowed the entry of $1.2 million USD in the country in 2017. (Victor, 2018).

The tourism cabinet aims at attracting more tourists to come to Kenya. For that, a project of acquiring a cruise ship facility was set (Victor, 2018) to target an increase in the amount of contribution of tourism in the national revenue.

1.1.3 Energy

Even though it fell from 65% to 15% around 2013-2014, thermal power stations still contribute to the electricity production in Kenya, justifying the imports of fuel to produce electricity. (Marion, 2018). Though the production of electricity in the country increased within the last two decades, many people in Kenya still do not have access to electricity, especially those living in rural areas. (M.Brazilian et al., 2014). Like in almost all African countries, electricity unavailability is one of the brakes that refrain the industrialization of the continent even though energy production potentialities are enormous (Kandeh, 2015). As an example, tidal energy can be exploited since the country is alongside an area with one of the strongest marine current in the world (Hammar et al., 2012).

1.1.4 Maritime transport and shipping

80% of the transport of goods worldwide is done thanks to maritime routes. By 2030, the volume of transported goods is expected to double. And by 2050, the figures are predicted to quadruple. (Sarah, 2018).

In my case of study, Kenya is famed for its exports of agricultural products, especially tea and coffee (OEC, 2018). Ensuring sustainable economic growth must keep into account the promotion of those exports while avoiding to harm the marine environment. Moreover, not all African countries have access to maritime sea. Kenya for instance is surrounded by three landlocked countries : Uganda, South Sudan and, Ethiopia. But, every country needs to import and export goods to satisfy the demand

of its population. (Julie, 2018). Kenya could develop its maritime shipping activities and evolve into a hub so that the country can cater its landlocked neighbours.

1.2 Purpose of the study

The purpose of this quantitative study is to determine how economic growth can be expected from orienting the economic activities towards blue economy, especially for developing countries like Kenya.

Actually, some developing countries in the Indian ocean like Mauritius have similar case to Kenya, and after having reviewed the literature, these countries have in common high attractivity for tourism, importance of trade and transhipment for the country's economy, high potential of industrialization but less level of environmental monitoring. (Durbarry, 2004). Kenya has another asset compared to Mauritius however, which is the potentiality for fishery development. However, none of the existing literature indicates the sector that best affect the economy of the country and the risk linked to its development on the marine environment. For that reason, I have decided to do a comparison of four sectors that highly contribute in the economy of Kenya, and that are linked to the maritime industry. Those sectors that will be deeply analysed in this study are: fishery, tourism, marine energy and, maritime shipping. I will analyse the contribution of those mentioned sectors to the country's GDP by building a model first so that I could have an understanding of the actual situation. If the model is fit for forecasting, I will do some forecasting about the evolution that could be expected in the selected sectors and finally, I would give some recommendations about the actions that could be taken to expect to get the best results in terms of sustainable blue growth in Kenya.

1.3 Research question and hypothesis

This study aims to analyse which of the energy, fishery, tourism and, shipping sectors affect the GDP more and need to be exploited to ensure sustainable economic growth.

Research Question: Which sectors are more affecting the GDP? And how to exploit them efficiently to ensure sustainability?

1.4 Limitations

This study was designed for Kenya, a country which is determined enough to get the best advantage of its coasts. All the data used in this analysis are typical to Kenya.

Even though the results of the analysis might be used for its similar neighbours alongside the east African coast like Tanzania, I do not advise to do so since each country is unique in terms of potentialities and assets. Also, every country faces its own issues. In that sense, it is not really encouraged to use the outcomes of this analysis for other countries.

1.5 Research outline

This dissertation is made up with four chapters following the classical IMRD structure for scientific paper writing. In chapter one is an introduction of the research topic encompassing the background about fishery, tourism, energy and shipping in Kenya, followed by the research question and the limitation of the research. In chapter two is given a description of the methodology used to collect and analyse data. Chapter three presents the findings from the established model. Chapter four is about discussion. Recommendations are given at the end of the discussion.

2 MATERIALS AND METHOD

2.1 Data

I fetched data about each section from different sources. In total, I gathered 10 variables with 56 observations ranging from 2005 to 2018 on a quarterly basis.

For energy, I found that the electricity production and the imports of fuel could be used to quantify the sector for the reasons that around 2013 and 2014, 65% of the electricity produced in Kenya came from thermal power stations functioning with large amounts of fossil fuel. However, since 2015 the part electricity produced from the thermal power stations decreased to 15% of the national electricity production thanks to clean energy promotion. (Marion, 2018). In this analysis, the electricity production represents the income that the electricity distributing company (KPLC) earned whereas the fuel imports are the expenses made to bring fuel to Kenya.

For fishery, I found available data about income from fishing only, and necessarily about income that fishermen and fishing companies earned for the considered time period of my analysis.

To quantify the shipping sectors, I have collected data about the exports of coffee, the exports of horticulture, the exports of tea, the total exports of merchandise, and, the imports of merchandise. The exports figures represent a measurement of the income got from the exports of the main agricultural products that Kenya is known for whereas the imports figures talk about the value of the imported merchandise.

Last, for the tourism sector, I have taken the revenue from hospitality industry to quantify the earning from the tourism sector.

Those data were taken from different sources such as:

- the Kenyan bank of statistics for the electricity production, GDP and, income from fishing
- the Central Bank of Kenya from which reports I got figures about the GDP and imports of fuel
- the Kenyan Tourism Board from where I got the earnings from the hospitality industry (hotels)
- the World Trade Organization for the exports of coffee, the exports of horticulture, the exports of tea, the total exports of merchandise and the total imports of merchandise

2.2 Methodology

In this part, I am trying to establish the relationship between the global economy, represented by the GDP and, the explaining variables, each of which belongs to one of the four sectors among energy, fishery, shipping and tourism.

For that I first established a multiple regression equation in which the GDP is being explained by the other variables. My equation looked like this:

$$GDP = \beta_0 + \beta_1 Electricity + \beta_2 Fuel_{Import} + \beta_3 Fishing + \beta_4 Export_{Coffee} + \beta_5 Export_{Horticulture} + \beta_6 Export_{Tea} + \beta_7 Export_{Merchandise} + \beta_8 Import_{Merchandise} + \beta_9 Hotel_{Revenue} + residuals$$

Then, I carried on a descriptive statistics analysis test which gave the mean, median and standard deviation.

Once the descriptive statistics done, I went on doing a collinearity analysis to check the variables that have similar values and hence similar trends throughout the study. I identified the pairs or groups that had a correlation score of more than 0.80 and I kept only one from the group after a gradual elimination of the highly correlated variables.

Following that step, I pinned the spreadsheet to the Eviews software to carry out an ordinary least square analysis on my series, which step algorithms are schematized in a diagram from the Quantitative Markets Analysis module (Satya, 2019) available in appendix 2. For that, I first checked for stationarity using the unit root test functionality. Following that I estimated the coefficients using the Student's test and

keeping into account the requirements from the stationarity results. I removed one non-significant variable at a time (that having the highest probability score among those whose score is exceeding 0.05) from the model's equation and run the Student's test again. I repeated that process until each of the remaining variables' probability score was below 0.05. Once I had my significant variables, I carried out the cointegration tests and did the required corrections as explained in the appendix 3. Following to that step I checked for autoregression and moving average thanks to the ARMA test. Then, I tested the residuals for normality, homoskedasticity and serial correlation. At any of these residual test steps, I did the required corrections such as the add of dummy variable in case the residuals were not normally distributed or the Newey-West and White test for heteroskedasticity and serial correlation matters. Detailed information on how those tests were carried out could be found in appendix 3.

All these steps done, I obtained the final equation of my model. The last thing I had to do was checking for the model's linearity to decide on whether it was fit for a breakpoint test and hence forecasting or not.

3 RESULTS

The results of the multiple regression analysis led to the results presented in this section.

3.1 Descriptive statistics results

The results of the descriptive statistics including the mean, median and standard deviation are represented in table 1. Another indicator, the Markowitz indicator was also given to judge on the dispersion of the data.

TABLE 1-DESCRIPTIVE STATISTICS OUTCOMES

THE FIGURES IN THE TABLE ARE EXPRESSED IN MILLIONS OF KENYAN SHILLINGS FOR THE MEAN, MEDIAN AND STANDARD DEVIATION. THE MARKOWITZ CRITERION (MEAN / STANDARD DEVIATION AND MEDIAN / STANDARD DEVIATION) IS AN INDEX.

	Mean	Median	Standard deviation	Mean/SD (Markowitz)	Median/ SD (Markowitz)
GDP	1,106,651.00	1,117,739.00	639,683.10	1.73	1.75
Electricity	23,750.96	20,016.00	16,270.92	1.46	1.23
$Fuel_{Import}$	61,060.27	60,867.23	23,586.96	2.59	2.58
Fishing	2,479.96	2,403.52	1,085.67	2.28	2.21

$Export_{Coffee}$	4,301.71	4,229.88	1,630.70	2.64	2.59
$Export_{Horticulture}$	16,972.49	17,435.62	5,573.34	3.05	3.13
$Export_{Tea}$	23,167.62	23,835.15	8,706.27	2.66	2.74
$Export_{Merchandise}$	1,296.55	1,399.50	247.98	5.23	5.64
$Import_{Merchandise}$	3,319.89	3,628.00	984.53	3.37	3.68
$Hotel_{Revenue}$	10,854.93	11,752.50	4,812.98	2.26	2.44

The fourth and fifth columns show very low difference between the mean and median which implies that all the variables follow a normal distribution. However, the low ratio between the mean/median and the standard deviation indicate a high dispersion of the values which is the case of the GDP and Electricity production. Economically, that dispersion could mean an alternance of periods of recession and periods of high growth, which is confirmed by the graph 1 available at Appendix 1. The same happens for electricity production which knew a period of stagnation before 2008-2009, period of a high political crisis, followed by an alternance of growth and recession. However, as shown in Appendix 1, the GDP graph and's trend is translated by slight growth within the period.

As for the Fuel imports, Fishing, Export of coffee, Export of tea, and, Hotel Revenue, the Markowitz criteria (mean/standard deviation or median/standard deviation) ranges between 2.26 to 2.66, which is considered moderate. Such ratio means a moderate dispersion of values around the mean. Economically, it means that the fluctuations in those fields are important enough to make those fields highly volatile and hence, risky to invest in.

Lastly, for the export of horticulture, the export of merchandise and, the import of merchandise, the ratio between the mean/median is high, or in other terms, a low standard deviation. These variables' values are closer to their means. These variables are not elastic to any disturbing event, they are more stable throughout the years.

3.2 Unit root test

The ADF(Augmented Dickey-Fuller) and PP (Phillips-Perron) criteria were adopted to carry out the unit root test, completed by a KPSS(Kwiatkowski-Phillips-Schmidt-Shin) confirmation in case of a conflict. It appeared that all the variables were stationary at first difference as shown in the table 2 below.

TABLE 2-UNIT ROOT TEST

I(1) MEANS THAT THE VARIABLE IS STATIONARY AT FIRST DIFFERENCE WHILE I(0) IMPLIES THAT THE VARIABLE IS STATIONARY AT LEVEL.

Variables	ADF	PP	KPSS
GDP	I(1)	I(1)	
Electricity	I(1)	I(1)	
$Fuel_{Import}$	I(1)	I(1)	
Fishing	I(1)	I(1)	
$Export_{Coffee}$	I(1)	I(0)	I(1)
$Export_{Horticulture}$	I(1)	I(1)	
$Export_{Tea}$	I(1)	I(1)	
$Export_{Merchandise}$	I(1)	I(1)	
$Import_{Merchandise}$	I(1)	I(1)	
$Hotel_{Revenue}$	I(1)	I(0)	I(1)

3.3 Correlation test

The correlation test showed a correlation exceeding 80% between the export of horticulture, the export of tea, the export of merchandise and the importation of merchandise. Also, it showed a very high correlation between the export of tea, the export of merchandise and, the import of merchandise. I could observe some high correlation between the export of merchandise and import of merchandise, as well as between electricity, export of tea and, export of horticulture. I concluded that the variables having the highest correlation with other variables were: export of horticulture, export of tea, export of merchandise and import of merchandise as shown in the table 3. I eliminated those variables from the model's equation one by one

based on their score of correlation with the other variables (the higher the score, the more likely I chose the variable to be removed).

TABLE 3-CORRELATION TABLE

HERE, CORRELATION COEFFICIENTS ABOVE 80% ARE HIGHLIGHTED IN RED.

	Electricity	Fuel Import	Fishing	Export Coffee	Export Horticulture	Export Tea	Export Merchandise	Import Merchandise	Hotel
Electricity	1.00								
$Fuel_{Import}$	0.50	1.00							
Fishing	0.76	0.49	1.00						
$Export_{Coffee}$	0.68	0.56	0.60	1.00					
$Export_{Horticulture}$	0.89	0.69	0.79	0.68	1.00				
$Export_{Tea}$	0.90	0.67	0.72	0.64	0.92	1.00			
$Export_{Merchandise}$	0.65	0.86	0.68	0.67	0.86	0.82	1.00		
$Import_{Merchandise}$	0.71	0.89	0.70	0.67	0.85	0.82	0.93	1.00	
$Hotel_{Revenue}$	0.64	0.63	0.55	0.49	0.74	0.77	0.73	0.71	1.00

The variables that remained in the model's equation after the collinearity test were: Electricity, $Fuel_{Import}$, Fishing, $Export_{Coffee}$, and, $Hotel_{Revenue}$.

3.4 Ordinary least squares

3.4.1 Student's test (T-test)

Not all the variables were significant after the first T-test as stated by figures of the table 4. The coefficient column keeps record of the estimated value of their coefficient in the equation whereas the probability of insignificance column is about the probability of the coefficient to be 0. Also, the R^2 of the model was 0.39 after the first T-test.

TABLE 4-RESULTS OF THE FIRST T-TEST

The R^2 in this first T-test was 0.39.

Variables	Coefficient	Probability of insignificance
Intercept (β_0)	0.09	0.71
Electricity	0.43	0.00
$Fuel_{Import}$	-0.09	0.14
Fishing	0.06	0.19
$Export_{Coffee}$	0.08	0.06
$Hotel_{Revenue}$	0.06	0.03

Fishing was first removed from the model as the variable had the highest probability of insignificance, followed by $Fuel_{Import}$. At the third attempt, I had a model that performed with an R^2 of 0.65 with all the remaining variables being significant. These three variables are Electricity, $Export_{Coffee}$ and $Hotel_{Revenue}$ with their coefficient and probability of insignificance summarized in the table 5. In other words, the GDP is more affected by those three remaining variables in my study.

TABLE 5-FINAL T-TEST OUTCOMES

Significant variables	Coefficient	Probability of insignificance
Intercept (β_0)	0.02	0.02
Electricity	0.32	0.00
$Export_{Coffee}$	0.09	0.00
$Hotel_{Revenue}$	0.18	0.00

3.4.2 Cointegration test

This step was made mandatory by the aspect of the GDP and all the significant variables to be stationary at first difference as stated in table 2. Three pairs were created: GDP-Electricity, GDP-$Export_{Coffee}$ and GDP-$Hotel_{Revenue}$ .Three error correction term variables were created from the residuals of each of the regression of those pairs, which were added to the model. However, after I run the Student's test to check on the significance of the error correction terms, none of them were needed in the model for their coefficients to be very close to 0. I did the test by adding them all together to the model's equation then by testing them one by one.

3.4.3 Auto regressive and moving average (ARMA) test

I started by adding AR(1) until AR(5) and MA(1) until MA(5) to the equation to find the degree of autoregressive and moving average processes in the model. As a result, none of the added terms was significant. The added AR and MA terms were then gradually removed and I concluded that there was no autoregressive nor moving average processes in the model.

3.4.4 Test of the residuals

3.4.4.1 Normality test

The Jarque Berra test revealed that the residuals of my model were not normally distributed. After one dummy variable was added, it turned to be normally distributed and the R^2 improved from 0.63 to 0.93 at this stage. However, some of the significant variables turned to be insignificant after the dummy was added. I then decided to exclude the dummy and considered that my model was not BLUE (Best Linear Unbiased Estimator).

3.4.4.2 Heteroscedasticity test and serial correlation test

My model's residuals presented no serial correlation nor heteroscedasticity. No correction was then needed.

3.4.5 Linearity test and forecasting

The stability test using Ramsey criterion showed that the model was not linear. In other terms, forecasting could not be done using the model. However, while going

back to the normality test and consider building a BLUE model, I had to drop two more variables and ended up with the Electricity and a dummy variable affecting the GDP. In that latter case, I had a linear model performing with an R^2 of 0.93. However, since my main goal was to see the main sectors affecting the GDP, I have decided to keep the non-linear model.

3.5 Final equation of the model

At the end of all the ordinary least square steps, I had a non-linear model with an R^2 of 0.64, in which the GDP is explained by the Electricity production, the $Hotel_{Revenue}$ and, the $Export_{Coffee}$. The equation of the final model is presented in the equation below:

$$GDP = 0.02 + 0.319\, Electricity + 0.178\, Hotel_{Revenue} + 0.088\, Export_{Coffee} + residuals$$

The intercept is 0.02. Also, in that equation the explanatory variables are ranked according to the importance of their coefficients.

4 DISCUSSION

In the previous part, I did an analysis to find out which sectors are more affecting the GDP. In this part, I am discussing about each of those sectors and how to develop them while targeting sustainable blue growth.

As given by the results of the regression, among the variables I have collected, Electricity production, Hotel revenue and Export of coffee are the variables that are affecting the GDP the most. In other terms, the growth of the economy should keep those three fields into account. However, developing intensively those three sectors might have some drawbacks to the environment, namely the marine environment. That is what we are going to discuss in this part of the document.

4.1 Electricity

The energy sector encompassed two variables: import of fuel and electricity production. The electricity production came out to be significant while the import of fuel did not. In fact, before 2013, 65% of the electricity distributed in Kenya was produced in thermal power stations functioning with fossil fuels. As a result, the import of fuel had a heavy weight on the expenses of the country. However, one year later in 2014, the geothermic station of Olkaria started its operations. In that station, electricity is produced from natural gas. This made the contribution of thermal power stations in electricity production fall from 65% to 15% (Marion, 2018), which resulted in a drastic fall of fuel imports between 2013 and 2014 as shown in the graph 3 in appendix 1. That said regardless of the source, the global production of electricity in the country did not fall but even increased. Reason for the increase could be to meet the ambition of the Kenyan Government to provide affordable clean energy for the entire population (Marion, 2018).

In my analysis, the positive coefficient of the Electricity production shows that the GDP and the Electricity production are moving in the same way: an increase in Electricity production can lead to an increase of the GDP by 0.319 units. From the situation in Nigeria, we could conclude that the same can apply in Kenya: electricity is vital to industrialization, and hence economic growth. Efforts are made to make electricity production in Kenya be more sustainable as this is part of the ambition of its Government to produce electricity from renewable sources only by 2020. (Marion, 2018).

However, there are still some unexploited sources with high potential like electricity production from marine sources. As stated by Hammar et al., the Somali-Agulhas system, that lies alongside the east African coast has one of the strongest power in the world. Exploiting that energy from current power allows efficient planning as well for the variation of the current is seasonal and not on a daily basis. As a result, power outcomes are highly predictable, which allows efficient planning. (Hammar et al., 2012). But, some disadvantages are still present when it comes to the exploitation of tidal energy. Developing that kind of energy might alter the current patterns. As a result, many changes can occur including the modification of current velocities and dynamics or some changes in the sediment and nutrient transports. Such facts might affect the marine ecology by disrupting the natural order existing in the benthic communities and by creating artificial reefs. (Bonar et al., 2015).

Wind farm electricity production can also be a good alternative for marine environment as the benefits are huge according to the figure 2 below.

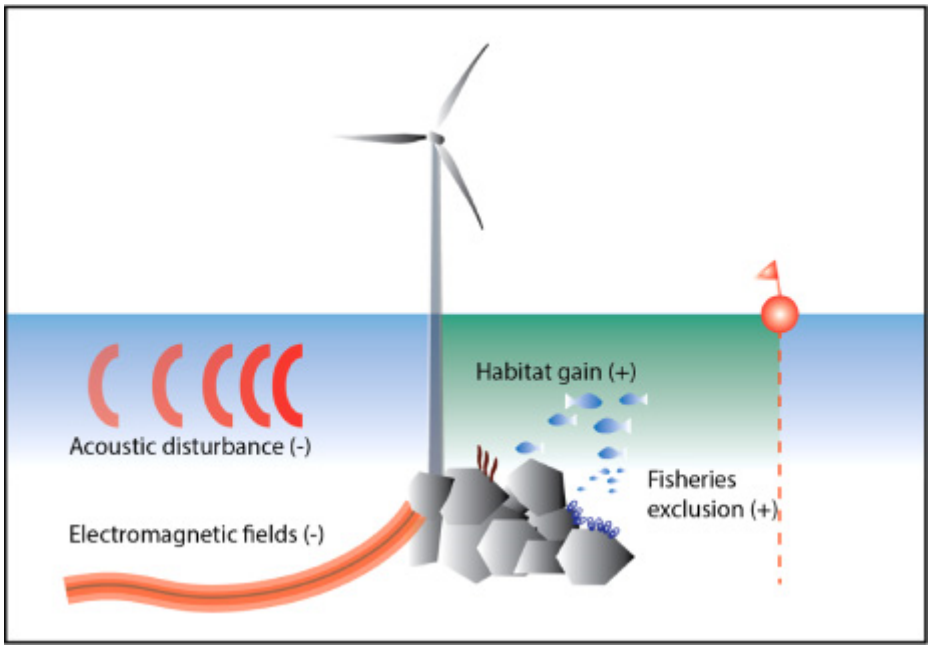

FIGURE 2-WIND TURBINE'S SURROUNDING ENVIRONMENT

THE PRESENCE OF BUOYS TO REDIRECT THE TRAFFIC AROUND WIND TURBINES RESULT IN THE LOWERING IN NUMBER OF VESSELS CIRCULATING AROUND THE FARM. AS A RESULT, LESSENED DISTURBANCE OF THE MARINE ENVIRONMENT CAN BE OBSERVED FOLLOWED BY HABITAT GAIN AS SHOWS THE IMAGE ON THE RIGHT OF THE TURBINE. ON THE LEFT ARE THE RISKS OF DISTURBANCE THAT THEY CAN CAUSE TO THE MARINE ENVIRONMENT BY THE ELECTROMAGNETIC FIELDS AND NOISE POLLUTION WHICH CAN HAMPER SOME SPECIES' ORIENTATION AND NAVIGATION (LENA ET AL., 2014). SOURCE: IOP SCIENCE.

In one side, wind farms provides clean and renewable energy. On the other side, wind farms also benefits marine environment as vessel traffic or fishing around them is reduced. In that sense, pollution risks such as oil spills is lessened as well, making the wind farms act as marine protected areas (MPA) contributing to the protection of the biodiversity in the area, but, they also help avoid the collision risks of mammals and sea turtles with ships. However, even though wind farms might present many good outcomes, they still present risks of collision with marine birds especially in periods of low visibility such as in the crepuscule or in periods of bad weather. (Grecian et al., 2010). Also, the fact that they have electromagnetic fields and noise that can disorient some species throughout their navigation and orientation.

4.2 Hotel revenue

Hotel Revenue was a variable in the tourism sector in my analysis. Theoretically, a variation in Hotel revenue is contributing to almost a sixth of the GDP as its coefficient is 0.178. In other terms, by increasing the hotel revenue six times and excluding the other sectors the GDP level would remain the same. But this is highly hypothetical and not the essence of the analysis, but to highlight the importance of tourism in the economic sector.

According to the data, there are seasonality in tourism in Kenya: there are some periods of growth and recession that alternate every year.

For the 2005-2008 and 2013-2015 periods, a period of growth is directly followed by a period of recession.

As for the period of 2009-2013, an important peak of growth happened in the first quarter of year and a second growth peak happened in the third quarter. The second peak however was less important than the first peak. Recession happened on the second and fourth quarters of the year for that period.

From 2014 to 2018, the sector knows recession only for the second quarter of the year, and growth for the other quarters. This implies a highly predictability of the tourism sector in one side, but also an understanding of the underlying reason for the recession in the second quarter. In April and May (in the second quarter of the year) actually, Kenya has a lot of rain. This might explain the drop in tourist arrivals resulting in the drop in hotel revenue.

Talking about the environment, a study done by Patrick Masau and Bruce Prideaux revealed that tourists coming to Kenya thought that hotels and tourism attractions were not sustainably managed. However, it was highlighted in that study that hotels had a big role to play in promoting environmental awareness in order to increase the number of visitors since more than 66.5% of the respondents to the study were willing to pay higher rate for the sake of the environment. (Patrick et al., 2003). In my case, this role for hotels is important since 17% of the GDP is coming from the hotel revenue.

If the country aims to increase hotel revenues, options include attracting more tourists or developing luxury tourism industry.

Increasing the number of tourists in the country has some benefits since it is the easiest way to increase the reach a growth in hotel revenues. This is because, in quantum mechanics is a principle that remains true in economics. In quantum mechanics, it is said that macroscopic pressure (that can be measured with a manometer) is the result of constant shocks of gas particles on the wall of a container. It is a fundamental truth: the sum of those small effects give the huge pressure. (Aslangul, 2018). Such theory also applies in economics, as suggested by Albert Aftalion in an article about productivity and income (Aftalion, 1911) that the basic revenue of a company in fact is the sum of the productivity in value of its workers and equipment. In that sense, the productivity of each worker and each equipment per hour could be assimilated to the shocks of gas particles and the basic expected revenue is the macroscopic pressure. Applying that theory in tourism, more revenue could be expected by increasing the number of individuals doing tourism in Kenya rather than promoting luxury tourism only for the tourism in Kenya seems to be intensive in some periods of the year. In order to regularize the income of the country, it is highly advisable to increase the number of visitors.

However, environmental issues come whenever it is about increasing the number of tourists in an area. As stated by Kilipiris et al. in a paper (Kilipiris et al., 2012), mass tourism is harming the environment more compared to alternative tourism. But, applying the macroscopic pressure law again, by adding up alternative tourists, it is likely to end up in a mass tourism. So, a choice should be made. Assuming that the State chose a policy of increasing the number of tourists regardless of it being mass or alternative tourists, some measures would be taken to handle the situation. These include increasing the number of hotel complex, creating new attractions, or building new roads and airports. In one side, by building new roads, risks of marine environment destruction are high since coral reefs are getting closer to construction sites if infrastructures are built alongside shorelines (Magdelaine, 2016). On the other hand, however, building long lasting infrastructures like roads present less harm to the environment since their lifespan are higher, and also, once they are built, they can be reused. Such characteristics align to the objectives of blue economy as conceived by Gunter Pauli. (Pauli, 2017).

As for an investor's point of view, increasing the number of hotels involve the construction of new buildings and facilities. Apart from the necessity to consider the relocation of some environmental habitats, the construction works might also involve large amount of sand which can reduce coastal defence. (Mary, 2018).

Last, for the hotel managers an increase of tourists implies an increase in consumption of goods and services. As a results, an increase in waste is also expected. The nature of waste is crucial as it determines the degree of destruction to the sea as most pollution in the seas and oceans originate from the land. As an example, most of microplastics that are released in the seas come from washing machines. Chemicals from wastewater are partly responsible of acidification and eutrophication of the oceans, which can result in coral reef bleaching and destruction of natural habitats (Mary, 2018). In that sense, thorough analysis of the amount of litters from hospitality industry such as plastics, papers, biodegradable waste, and, chemicals contained in wastewater is more than useful to limit the drawbacks of tourism development while still increasing revenue and targeting economic growth from the sector.

A cruise business is also planned to get more income in the country from tourism. (Victor, 2018). A study from the Adriatic sea about the cruise tourism environmental impacts presented some issues that need to be tackled when thinking about developing that field. Cruise ships are known to dump waste in the sea once a day, to emit CO_2 and suspended particles and to transport ballast water. Those waste consist of a mix of organic and inorganic compounds including medicines, microplastics and hazardous chemicals which can cause hypoxia and eutrophication when released in oceans. Also as to fight against microplastic pollution, some cruise ships have had installed incinerators on board. These incinerators however produce ashes with high concentration of toxic substances and hydrocarbons. Combined with the emissions from heavy fuel oils burnt in the engine, serious consequences of air pollution can be expected (Petrosillo et al., 2009). Apart from that, the black water and grey water from showers, laundries and pools from cruise ships introduce nutrients to the sea impacting on the blooming of phytoplankton which leads into the reduction of light for other marine organisms and hence, a disruption. (Carić et al., 2014). That study carried out in the Adriatic sea suggests that the cruise ship industry is highly

polluting with its production of waste estimated at 24% of all the waste in the shipping sector. To minimize the harmful effects of cruise industry as ambitioned by the Government, some measures need to be done.

4.3 Export of coffee

Export of coffee is the variable from the shipping sector that was significant in my analysis. It came out to contribute to 0.088 to the GDP. Though the coefficient is around 1/10, still it is important to the economy as this variable could be observed both in the agricultural point and as a component of the shipping sector.

However, the graph of that variable in appendix 1 highlights the existence of a recession in the fourth quarter of every year. This can be the result of the periodicity of production as the yields are made once a year. Also, an explanation to that phenomenon could be that 70% of the exported coffee from Kenya is produced in the country whereas 30% is imported. But, the world fluctuation on prices of coffee can also explain the cycles since the analysis was carried out in values and not in quantity.

In sum, revenue from the export of coffee is contributing to the economy. However, its analysis in terms of shipping only is biased since in one side, its growth throughout the years is low: the income from the exports of coffee doubled in eight years. Considering an inflation rate of an 7.83% per year in average (Statista, 2018), the value of Kenyan shilling would have decreased in value at 109.62% from 2005 to 2018. In other terms, 1 Ksh in 2005 would worth 2.09 Ksh in 2018 which is the double of the initial value. Bringing that analysis in the export of coffee of Kenya, the increase by two times of the value of the exports may mean exporting the same amount of coffee every year. The increase could be just an effect of inflation. However, since data about the quantity of exported coffee is not available, this option could not be considered further. However, Kenya's coffee exportations are not totally produced in the country. 30% of the exports are still imported from other countries (Ticha, 2017). Economically speaking, this could be the upper limit of the Kenyan agriculture, but it also could mean that producing more coffee would result in a decrease of the price which won't translate into economic growth. On the other side, it also depends on other factors including environmental conditions or new countries entering the market. However, we are going to assume that increasing the quantity of exports of coffee

would be good for the Kenyan economy. As a result, there would be more shipping. An increase in shipping goes along with more ships coming and leaving from the ports. As a result, the risks of pollution may increase. These risks of pollution include air pollution (CO_2 and other greenhouse gas emissions), biological pollution (introduction of invasive species from biofouling and ballast water), or chemical pollution through the waste from grey water rejected into the sea from ships. Another great risk of disturbance of the ecosystem also includes the risk of collision with mammals which can lead to the disruption of the food chain as big predators might decrease in number. The direct result of such food chain disruption include an abnormal growth of microscopic bodies like phytoplankton which in return can alter the amount of light in the oceans and destabilize other beings. (Mary, 2018). Shipping however, does not relate to ship only, it also involves other stakeholders including shipping companies and ports. In order to ensure the sustainable profitability of shipping, strategies about the preservation of marine environment on ports should be encouraged and shipping companies as well as the port authority have huge responsibilities in the mitigation of marine pollution.

Some good incentives like the limitation of emissions from ships via the MTCC initiative in terms of emission reduction and cold ironing are already implemented in the port of Mombasa. Kenya is also member of the antifouling convention, which enables its port state authority to control ships' antifouling paints whether they contain TBT or not. Such measures are already applied in the first port of the country in Mombasa, which are believed to be helpful to ensure sustainable growth in the shipping field. However, some practices could better facilitate the monitoring of the level of sustainability on the port through the use of indicators as stated in ISO14000 (Bateman, 1996). These include the indicators on management performance (MPIs), which are based on the efforts that aim for better environmental performance in the port. Also, operational performance indicators (OPIs) are part of that standard. They measure the level of sustainability of operations carried out on the port. Last component on the standard are the environmental condition indicators (ECIs) which reveal the condition of the environment in the port. (Bateman, 1996). These indicators can be used prior to creating some new indicators that are proper to the situation in Kenyan ports in order to monitor the health of the environment on areas where shipping is getting developed.

4.4 Recommendations

Electricity production from geothermal source was a good option for the environment as it drives away from fuel. It has some negative social impacts however, like the relocation of population for the site building. Production of energy from marine sources including tidal energy and offshore wind farms might be a good solution. However, they still present some risks to the ecology. Some of the risks are not well analysed yet because of the lack of reports such as the case of noise pollution or the underlaying reason for the modification of current flow around the devices near the seabed. (Bonar et al., 2015). When it comes to a project of marine energy development, I would suggest a thorough environmental analysis to choose the best form that offers a good balance between the maximization of the power supply and the minimization of the risks linked to marine environment in order to ensure sustainable growth in the energy sector, and hence growth in economy.

As for tourism, I would suggest more sustainable management of tourism attractions and hotels as well as an increasing of environmental awareness for tourists through brochures and flyers, and the integration of best practices to avoid the waste of resources. I would also advise that strong environmental analysis is performed before any infrastructure construction is carried out. That is to allow the State decide on the best measures to adopt in terms of lessening the burden on the environment. Moreover, I also urge the use of indicators to monitor the environmental footprints of establishments that are parts of the hospitality industry. For example, an index to monitor the paper consumption, an index to measure the handling of greenhouse gases, and, an index to measure the level of chemicals in waste water. This can be done through a financial audit by checking the invoices and inventory of hotels to find out their consumption of napkins and paper and to check on the amount of chemicals that are used through their cleaning products. As for the emissions, I strongly encourage that investors in the hospitality industry invest in facilities like incinerators and recycling facilities, and use the CO_2 produced from the incineration of the waste for some projects like spirulina farming. Otherwise, if it is costly enough for business owners to implement, the State has a duty to build recycling stations where wastewater is purified from chemicals and plastics before being poured into the sea.

It would also be better to train personnel in the tourism business to increase their environmental awareness to ease the carrying out of all the measures that are taken.

Regarding ports and shipping, some efforts on complying to international conventions should be continued. I also think that there should be a creation of some establishments to analyse the level of destruction caused by imported species from biofouling and ballast waters like what was done in Australia in the 1990s (Bateman, 1996). Also, the use of indicators to monitor the ports' environmental performances should be encouraged. (Puig et al., 2014).

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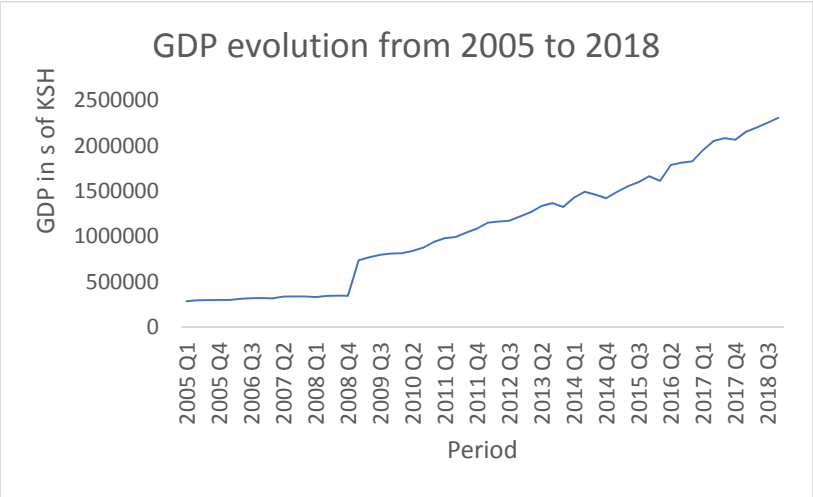
APPENDIX 1 – Graphs of the variables

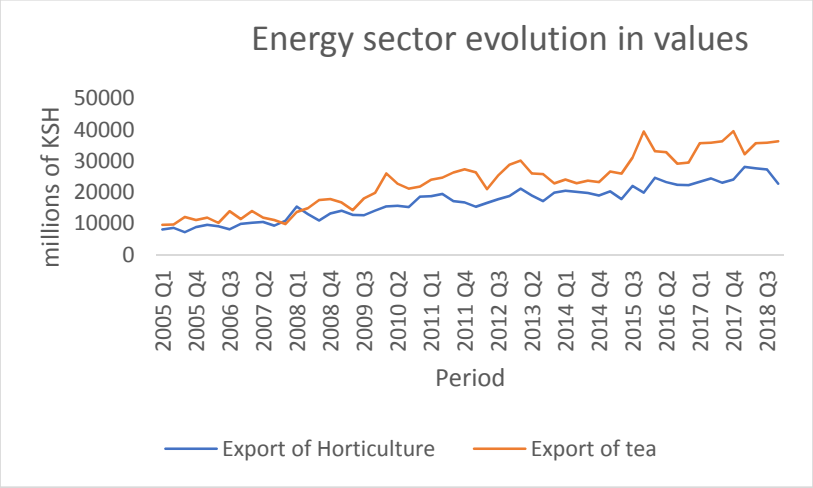
1- Graph of the GDP for 2005-2018 on a quarterly basis



GRAPH 1-EVOLUTION OF THE GDP
(IN MILLIONS OF KENYAN SHILLINGS)

The GDP from 2005 to 2018 evolved in 2 phases. The first phase from 2005 to 2008 is a period of stagnation. Then, a period of growth follows from 2008 to 2018. The country knew a period of crisis in 2008 after an election. Then, series of reforms were carried out. These reforms were oriented toward the emergence of the economy and was aligned with international policies such as millennium development goals. However, that period was marked by a recession before the economy rose again. That recession is not observed here but rather a stagnation illustrates the period. In that case, the error might be from the data recordings which might have been extrapolated.

2- Graph of the energy sector evolution for 2005-2018 on a quarterly basis



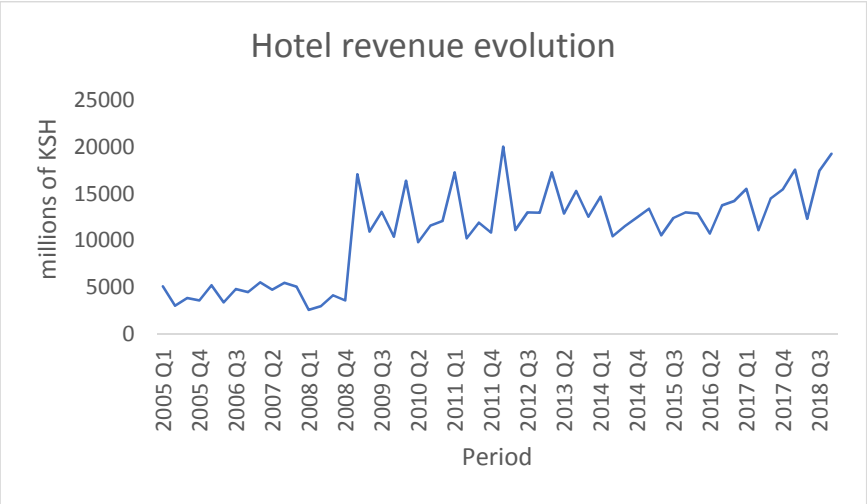
GRAPH 2-EVOLUTION OF ELECTRICITY PRODUCTION AND FUEL IMPORTS (IN MILLIONS OF KENYAN SHILLINGS)

Before 2009, the electricity production seems to be in stagnation. Alike the GDP, the cause might be the political crisis or some errors in data recordings. Then, from 2009 to the last quarter of 2015, every change in the import of fuel is translated in the electricity production. The only difference is that the change lasts longer in the electricity production whereas fuel imports fluctuate a lot. From 2016, fuel imports variation did not have significant impacts on the electricity production anymore. This could be explained by the inauguration of the geothermal site of Olkaria (Marion, 2018). Also, from 2016, the electricity production follows a cycle with a highest peak of growth in the first quarter of the year followed by a slight and progressive recession for the second and third quarters, reaching its lowest peak in the fourth quarter of the year. Reason for that peak could be diverse, but I would suggest that it is linked to tourism as the amount of revenue from tourism is at its highest in the first quarter of the year. This might be translated in more lighting, more electricity consumed for industrial production of food and services.

Choosing the electricity production to contribute to this analysis might be somehow tricky since the access to electricity might be a result of the increase of purchasing power. In that sense, the growth of electricity production might be explained by the GDP and not the other way round. However, the literature about energy access suggests that the electricity availability constitutes a brake to overcome to achieve the

industrialization of the African continent. In other terms, the more people have access to electricity, the more economic growth there is expected. (Kandeh, 2015).

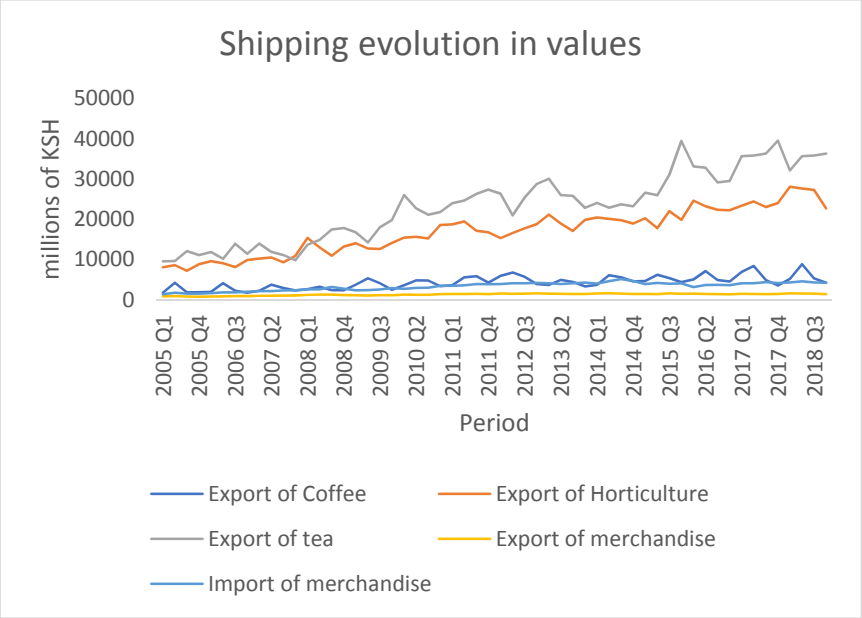
3- Graph of the hotel revenue evolution for 2005-2018 on a quarterly basis



GRAPH 3-EVOLUTION OF HOTEL REVENUE (IN MILLIONS OF KENYAN SHILLINGS)

The hotel revenue is marked by an alternance of growth and recession. This might be caused by the climate as it rains in April and May. The drop is at its deepest in all the second quarters followed by a steady increase through the third and fourth quarters to end up at its highest peak in the first quarter of the following year. This variable has the same trend as the GDP, electricity production and fuel imports with a stagnation before 2009. However, through the stagnation period, the same patterns of alternance of growth and recession still applied.

4- Graph of the shipping evolution for 2005-2018 on a quarterly basis



GRAPH 4-EVOLUTION OF SHIPPING
(IN MILLIONS OF KENYAN SHILLINGS)

In this graph, the imports of merchandise are steadily outweighing the exports of merchandise through the maritime way since 2007. In that pace, normally the trade balance should be translated in a deficit, and hence a recession of the GDP. However, throughout the period of study, the GDP was marked by a steady increase. An explanation could be that since the data included maritime trade only, exports to neighbouring countries through land transport are ignored in this study. However, those re-exported merchandise could contribute to the imports of Kenya.

Export of coffee is stable throughout the years, though it knows seasonality. Microeconomically speaking, investing in coffee in Kenya could be safe but won't allow huge amounts of yields. However, in terms of macroeconomics, stagnation of the revenue from the exports of coffee is not a good sign. When coupled with monetary depreciation, it means an economic recession. But the cause for that stagnation can also be diverse since coffee's price in the international market depends on many factors such as the appearance of new productors driving a change in offer or also, the degradation of the environment leading to a decrease in the yields.

APPENDIX 2 – Ordinary least square analysis steps

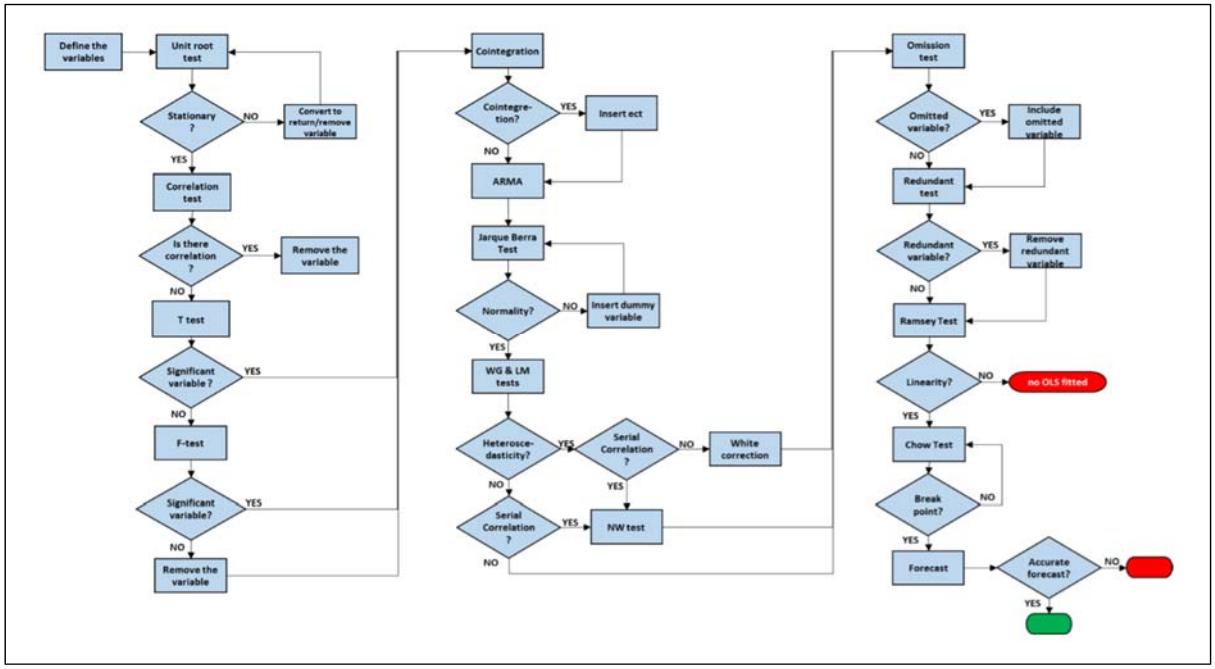


FIGURE 3-SUMMARY OF THE OLS ANALYSIS (SATYA, 2019)

The rectangle shaped figures in the diagram indicate the steps with the name of the test or action to be carried out. The diamond-shaped figures represent the alternatives that exist within the test and hence, the choice to make. The final steps are indicated in green in case a BLUE model is created or in red in case the model is not fit for forecasting.

APPENDIX 3 – Handling cointegration, heteroscedasticity and serial correlation

1. Cointegration

After I formed pairs between the dependent and the independent variables, I run a regression for each of the pairs and checked for the stationarity of their residuals. In case the residuals were stationary at level, I concluded the existence of cointegration and did the required correction which was adding an error correction term to the equation of the model. That error correction term actually was a created variable, having the same values as the residuals. But, when adding it to the equation, it had to be at a lag -1. In simpler form, the error correction term is like what could be seen as $ect_{variable}$ as explained in the equations in the example.

Example:

The pair I have is Y and X_1 .

The equation of the regression is $Y = \beta_0 + \beta_1 X_1 + residuals.$

After I run the regression, I create a new variable called $ect_{variable}$ where $ect_{variable} = residuals.$

Then, I add that $ect_{variable}$ at a -1 lag to the initial equation of the multiple regression that looks like:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + ect_{variable}\,(-1)$$

2. Heteroscedasticity

In this analysis, as I used Eviews, the heteroscedasticity was carried out easily doing a White test. The hypothesis to be tested was “The residuals were heteroscedastic”. In case the probability of the t-statistic of the result was not exceeding 0.05, then the residuals were homoscedastic. In the opposite case, they were heteroscedastic and some corrections need to be applied. But before deciding on the appropriate corrections, a serial correlation analysis has to be carried out.

3. Serial correlation

The serial correlation test is a test carried on to find out whether there was serial correlation among the residuals. In Eviews, when carrying out this test, lags have to be included. These lags numbers vary depending on the frequency of the data: 2 if the data are in an yearly basis, 6 in case of a quarterly basis or 14 for data in monthly basis. The hypothesis that is tested while doing this test is "There is serial correlation among the residuals". In case the probability of the t-statistic of the results exceeds 0.05 then the null hypothesis is verified and corrections must apply. Corrections to be carried out are summarized in the table below

TABLE 6-CORRECTIONS TO BE CARRIED OUT IN A RESIDUALS DIAGNOSIS

	Homoscedasticity	*Heteroscedasticity*
No serial correlation	No correction	White correction
Serial correlation	Newey-West correction	Newey-West correction

Applying the corrections is something very simple. To do so in Eviews, when estimating the coefficients of the regression, some parameters have to be chosen. At options, under covariance method, the "Hueber-White" option needs to be enabled in case a White correction is required. For a Newey-West correction, the "Newey-West" option should be enabled instead of the Hueber-White. Then, the estimation of the coefficients of the regression will take the corrections into account.