GRAVITY MODEL ANALYSIS ON OF CHINA ONE BELT ONE ROAD PROJECT ON THE PORT DEVELOPMENT BASED OF WEST AFRICA COUNTRY (CASE OF GHANA)

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Abstract

The one belt one road (OBOR)" initiative is one of the most important projects which aimed to boost and develop the bilateral trade behavior between China and other countries. However, there is lack of information regarding Africa Countries. Therefore, this paper empirically assesses the variables that may impact on the trade potential between China and Ghana, as well as other West Africa Countries. Hausman test and the gravity model performed in this study demonstrated that the gross domestic product and the population size are the two key variable

accounting for the bilateral trade between China and West Africa countries. Moreover, the China One Belt One Road strategy was found to have significantly impact of the total trade value with West Africa countries. It was shown that countries such as Ghana, Guinea, Cote d'Ivoire, and Nigeria have a great trade potential future with China. Furthermore, some strategies have been proposed to stimulate the China One Belt One Road strategy with Africa countries.

Keywords: One belt one road, Trade, Gravity model, West Africa port

INTRODUCTION

Opened in 1962, Tema Port is one of the biggest seaports in Ghana. Ghana and China established their diplomatic relations in 1960. Due to his strategic location Ghana have a lot of influence in the economic activity in the western Africa. The goal of the One Belt One Road initiative (OBOR) implemented in 2013 by President XI JINPING was to link Asia, Africa and Europeans countries by overland roads and Maritimes routes, which who will involve building infrastructures and create many jobs in those countries. The OBOR has received a lot of supports and participations from Asia European and African countries, which accelerate the creation of a cooperation platform (DOSSOU, 2018). The principles of the 21st Maritime Silk Road strategies are mutual benefits for all the countries members of the OBOR, free cooperation and market operation (Klinger & Muldavin, 2019). It will have a positive impact on chine outbound investment, these strategic lands maritime passages are going to be built and the international logistics will be established and well developed (Carter, 2018; Dai, Qu, Wen, Li, & Xie, 2017).

In the beginning of the ''one belt one road'' strategy proposed by China Ghana was not a part of the initiative later on Ghana officially accepted. The implementation of this strategy is going to help many Chinese companies in their investment in Ghana and will be good for the economic growth of the country. Due to the net increase of labor cost in china a lot of Chinese factories already start to move in Africa where labor cost is still low. The Tema port serves as a gateway port for neighbors' countries such Niger, Mali and Burkina Faso. Ghana political and economic stability has made him one of the leaders in the western Africa and also a good business partner with China. West Africa area is the most populated region in Africa with its population estimated as 320.347.000 million people and it considered by Chinese investors as the biggest market in African continent(Strauss & Saavedra, 2009). Investing in Ghana is an advantage cause of his position close to the others Africans countries and not so far from Europe compared to China. The goods produced in Ghana can easily reach the African market

and the European market. Tema port will be playing an important role a large quantity of equipment will be imported from china by Chinese investors via the port to open up factories and the products produced by the factories will be exported also via the same port. Here these are the questions that need to be ask: How Tema port will benefit from the One belt One Road strategy? The impact of the one belt one road can it easily be seen? What is the current trade situation between China and Ghana? What strategies Tema Port Authority can use to develop Tema Port? Did the two countries have any trade potential? This article will help to find answers to these questions. The higher the demand of a country for goods becomes the higher its trade volume will increase; in this article the Gravity Model will be used for estimate the potential trade between China and Ghana also a forecast will be made on the China export trade value to Ghana.

LITERATURE REVIEW

Tema Port receives a lot of ships coming all over the world and particularly from China main ports such as Guangzhou port and Shanghai port. China understood quickly that development of ports in his country will have a direct positive impact on the economic growth of his country. China is the 2nd largest economy in the world after the United States and it became an economic for a lot of others countries. All transactions and innovations around the "One Belt One Road" are considered to be really important for foreigners and Chinese scholars. "OBOR" strategy has a positive impact on Tema port, there are many research papers and articles that report on the OBOR but few has ever written about this topic; we hope that in the close future it can have great importance for future research or others studies.

Some factors might be influencing the trade potential between countries. In their article Gebrehiwot and Gebru (2015)stated that Ethiopia trade potential can be estimated with major trading partners who are using a dynamic approach based on panel dataset , later on findings reveals that the dynamic gravity model is a fit for the data and also indicate the presence of the hysteresis in the trade and that the gravity variables found were significant(Gebrehiwot & Gebru, 2015).

Others authors such as Tumwebaze and Nahamya (2015)assessed the factors that may affect the Uganda exports through the years 1980-2012 by means of gravity model trade. The outcome revealed that the Uganda domestic gross product(GDP),importers GDP, importers GDP Per Capita as well as per capita GDP difference between Uganda and its business partners exchange rate and contiguity have a very good and statistically effect on Uganda exports. But the Uganda GDP per capita and distance with their business partners does not have a positive impact on Uganda export flows (Tumwebaze & Nahamya, 2015).

Some Chinese scholars such as Ting (2016)analyzed the Zhejiang clothing export trade potential under the "OBOR". The authorutilized the traditional trade gravity model which is based on data clothing export in Zhejiang Province in China. The outcome revealed that there is a biggest market potential in Brazil, Africa countries and Australia for Zhejiang province clothing notwithstanding the huge distance with these countries. Furthermore, contrary to Quenouille (1949) and Kendall (1954), Ledolter (2009)assess the bias and mean square error of the last squares, the bias corrections in addition to the mean square forecast error and coverage of 95% of predicted interval by means of the bias least squares estimate or one of the bias corrected versionsLedolter (2009).

GRAVITY MODEL METHODOLOGY

Gravity model established by Hermawan (2011) depicts that the trade relationship between two countries is positively related to their GDP and negatively associated with the distance among them (Ahmad & Garcia, 2012; Thapa, 2012). Later, in the early 1960s, a modified gravity model (eq.1) built by Linnemann (1966)was found to be efficient and accurate in the modelization the international trade flow based on the distance between the capital of two countries and the ratio of their GDP as an indirect indicator of transaction costs (Broekel, Balland, Burger, & van Oort, 2014; Mehchy, Nasser, & Schiffbauer, 2015).

$$Y_{ij} = A(X_i X_j)/D_{ij} \quad \text{(eq.1)}$$

Where X_i and X_j are respectively the GDP of countries i and j; D_{ij} is the distance between the capital of the two countries i and j, C is the constant, and Y_{ij} is the bilateral trade between i and j countries

To easy computed this empirical model, the original gravity model was transformed into a linear logarithm form with adding random term

$$LnY_i = Y_0 + Y_1 ln(X_i X_j) + Y_2 ln(D_{ij}) + \varepsilon_{ij} \quad \text{(eq.2)}$$

Where, Y_0 is the constant term;ε_{ij} is the random term, Y_1 and Y_2 are regression coefficient reflecting the elasticity with regard to the GDP of the two countries (X_i and X_j) and their geographical distance (D_{ij}).

In line with previous studies (Gros & Gonciarz, 1996; Rose, 2004) the population size, as well as policy trade (as the fact that the two countries are member of the world trade organization), have been used as explanatory variables in addition to the key basic variables (distance between the two capital, and GDP) of the gravity model. The policy trade refers to if the countries engaged in bilateral trade are member of the world trade organization. Hence, the trade policy was used as dummy variables. Furthermore, export referring to China as an export

country was selected as the dependent variable. Therefore, based on equation 2 a gravity model depicting the bilateral trade between China and West Africa countries can be depicted by equation 3

$$LnT = \Upsilon_0 + \Upsilon_1 ln(X_i X_j) + \Upsilon_2 ln(D_{ij}) + \Upsilon_3 ln(Y_i Y_j) + \Upsilon_4 ln(K_{ij}) + \varepsilon_{ij} \quad \text{(eq.3)}$$

Where, Υ_0 is the constant term; ε_{ij} is the random term, $\Upsilon_1, \Upsilon_2, \Upsilon_3$ and Υ_4 are regression coefficient reflecting the elasticity with regard to the GDP of the two countries, their geographical distance, the population size of the two countries, and their membership to the World Trade Organization (WTO).

DATA ANALYSIS

For this study, the secondary data were gotten from the China State Statistical Bureau and World Bank groups representing the data from 2009 to 2017. Moreover, the geographical distance from China and selected West African countries was obtained from Travel Distance Calculator Webpage. Besides, the adhesion of countries to the World Trade Organization. were verified from the official website of the World Trade Organization.

Figure 1 shows an imbalance in the value of Import-Export trade between China and Ghana. This was more significant since 2015 as the resultant of the implementation of the new Chinese trade policy One Belt One Road (Tekdal, 2018).
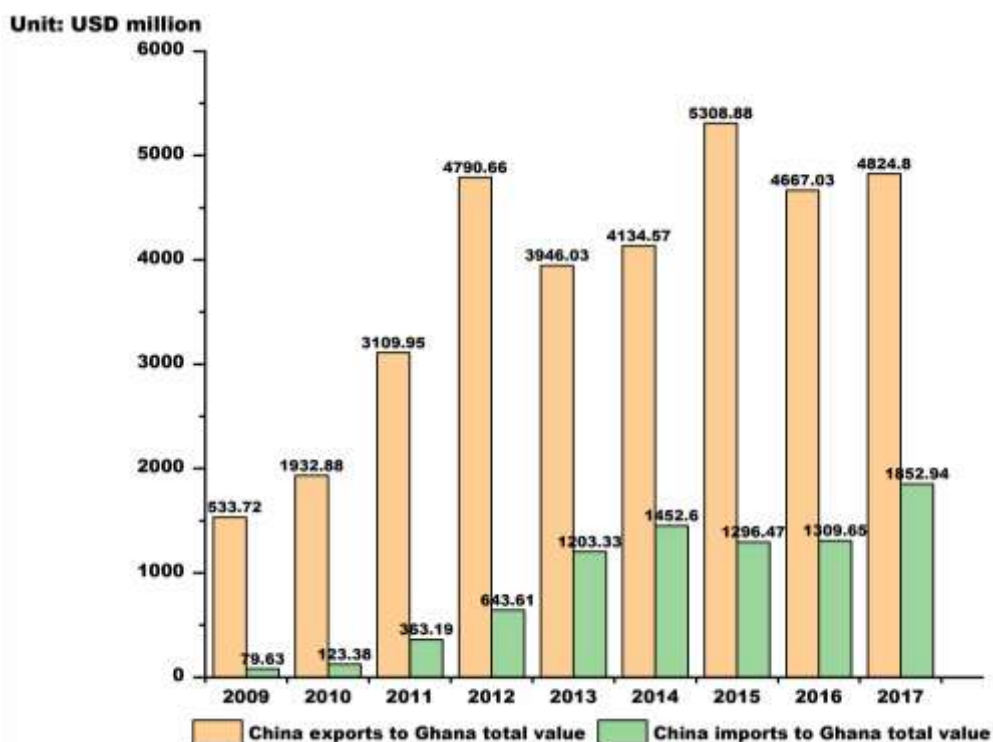

Figure 1: China-Ghana total import-export trade value (2009-2017)
Source: China State Statistical bureau, 2018.

Moreover, the total trade value disequilibrium in favor of China depicts the fact that West African countries are likely to be more dependent on the goods exported from China. It can be seen from the exports and imports goods from China to Ghana (Table 1), that in 2017 the consumer and intermediate goods were the main exported goods, while the raw materials and fuels were the key imported goods.

Table 1: China exports and imports goods to Ghana in 2017

Product groups	Exports (USD Thousand)	Imports (USD Thousand)
Capital goods	1163425.95	68.35
Consumer goods	2412204.76	1054.72
Intermediate goods	1217362.51	25736.32
Raw materials	31066.44	1826023.32
Animal	22894.3	1602.65
Chemicals	346575.58	424.92
Food products	162401.11	23467.07
Footwear	297661.13	1.82
Fuels	11038.49	1462450.77
Hides and skins	101469.35	3.15
Machinery and electricity	993144.97	73.26
Metals	723832.72	1340.57
Minerals	10887.42	262004.39
Miscellaneous	287302.97	93.72
Plastic or rubber	353065.89	557.22
Stone and glass	188524.63	2279.06
Transportation	460610.7	28.31
Vegetable	90738.55	4581.93
Wood	138406.54	94030.24
All products	1852939.05	1852939.05

Source: World Bank groups, 2017

(https://wits.worldbank.org/CountryProfile/en/Country/CHN/Year/2017/TradeFlow/EXPIMP/Partner/GHA/Product/all-groups#)

Hausman Analysis

In order to select the most efficient model, the Hausman test was performed to select between the random effect or the fixed model. The result tabulated in Table 2, revealed that the fixed effect model is more accurate ($p < 0.05$).

Table 2: Hausman test

Correlated Random Effects - Hausman test

Pool: POOL

Test Summary	Chi-Sq.Statistic	Chi-Sq.d.f	Prob.
Cross-section random	34.4506	2	0.0000
	44		

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff)	Prob.
LOG(GDP)	0.650810	0.802036	0.000759	0.0000
LOG(Pop)	0.597046	-0.613667	0.045081	0.0000

However, the fixed effect model is limited to predict variables that do not vary over time. Hence, dummy variables such as membership of the WTO and the geographical distance between capital must exclude from the model analysis. Therefore, the following equation will be used for the modeling

$$LnT = \Upsilon_0 + \Upsilon_1 ln(GDP) + \Upsilon_2 ln(Pop) \quad \text{(eq.4)}$$

Where, Υ_0 is the constant term; ε_{ij} is the random term, Υ_1, and Υ_2 are regression coefficient reflecting the elasticity with regard to the China and Ghana GDP, as well as the China and Ghana population size of the two countries

Empirical Analysis

The empirical analysis was performed to determine if the selected explanatory variables are significant to explain the bilateral trade between seven West Africa countries and China. Therefore, based on the Hausman test output, the generalized least square method with a fixed effect model using the weight function was carried on in Stata 15. The statistical output of the empirical test describing the bilateral trade between seven West Africa countries and China is tabulated in Table 3 confirmed the accuracy of the selected model It can be shown that the selected variables are accounting for 96% of China's bilateral with those Africa countries.

Table 3: Auto correlation of the residual sequence

Sample: 2009-2017

Include observation: 9

Cross-section included: 13

Total pool(balanced) observation: 85

Linear estimation after one-step weighting matrix

Variable	Coefficient	Std.Error	t-Statistic	Prob
C	-39.681	7.601	-5.222	0.000
LOG(GDP)	0.697	0.044	16.763	0.000
LOG(Pop)	0.585	0.246	2.513	0.014
Fixed Effects (Cross)				
Ghana	1.381			
Benin	-1.417			
Guinea	2.042			
Cote Ivoire	-0.155			
Nigeria	0.971			
Senegal	-0.711			
Togo	-1.146			
Effects Specification				
Cross-section fixed (dummy variables)				
Weighted Statistics				
R-squared	0.962	Mean dependent Var		12.591
Adjusted R-squared	0.923	S.D. dependent var		3.661
S.E. of regression	0.325	Sum squared residual		7.986
F-statistic	238.048	Durbin-Waston statistic		0.728
Prob (F-statistic)	0.000			

Thus, with regards to Ghana and, if the actual relation and condition within these countries stay the same, increasing 1% of their GDP will lead to an increase of 0.697% of the exportation goods from China to Ghana. In the same way, the increase in population size of 1% will result to an increase of 0.585% of the total trade value. This depict that the GDP and the population size are the two main variable responsible for the goods exportation from China to Ghana which is related to the bilateral trade relationship between the two states.

ANALYSIS OF THE TRADE POTENTIAL AND RESULTS OF THE FORECASTING TRADE VALUE

The ratio of the predicted and the current trade value (Tp/Tc) was computed in order to assess the effectiveness of the model to depict the current bilateral trade activities. Hence, the higher

the ratio, the higher the trade potential. Thus, a ratio closer to 1 highlight an excellent trade relationship between the countries. Based on Table 4 output, it can be shown that the trade potential of China with Guinea, Cote d'Ivoire, Ghana, and Nigeria is very high contrary to that of Togo, Senegal, and Benin. In order to confirm the effectiveness of the model to predict the bilateral trade, the secondary data were used to predict the total trade value between China and the seven West Africa countries selected.

Table 4: Analysis of potential trade between china and
seven West African countries from 2009-2017

Years	China to Ghana	China to Benin	China to Guinea	China to Cote Ivoire	China to Nigeria	China to Senegal	China to Togo
2009	0.30	0.34	0.75	0.56	0.96	0.33	0.21
2010	0.85	0.82	1.50	1.04	0.42	0.65	0.28
2011	0.98	0.78	1.95	0.48	0.86	0.87	0.26
2012	0.40	0.71	1.40	1.12	0.53	0.95	0.44
2013	1.34	1.51	1.89	1.38	0.32	0.87	0.78
2014	1.64	1.73	1.78	1.62	0.78	0.91	0.85
2015	1.77	0.35	1.85	1.47	1.55	0.11	0.97
2016	1.85	0.45	1.96	1.98	1.45	0.36	1.18

It can be seen from Table 5, that the predicted value match significantly with the 95% level of confidence to that of the actual value. Furthermore, for 2017 the potential trade of Ghana, Guinea, Cote d'Ivoire and Nigeria with China was found to reduce conversely to Benin and Senegal, while for that of Togo remain stable. This may be attributed to the chosen factor in this study which may alter the predicted value (Lin, 2015).

Table 5: predicted potential trade between china and
seven West African countries in 2017 (trade value in millions of us dollars)

Year 2017	China to Ghana	China to Benin	China to Guinea	China to Cote Ivoire	China to Nigeria	China to Senegal	China to Togo
Actual value	3269722	1306357	841735	1148511	8240504	1385322	1280227
Predicted value	3040840	1267170	942743	1251880	7746070	1413030	1472260
Trade potential	0.93	0.97	1.12	1.09	0.94	1.02	1.15

SUGGESTED STRATEGIES

Ghana population and GDP are being growing more and more these last years. We can observe that the population being consuming more Chinese goods, this change is due to the price and affordability of the Chinese goods in the Africa market. From there we can see that the volume and the trade export value of china to Ghana have being increasing in the last few years as we can see in the Figure 1.

The research finding shows the importance and advantage of developing the Tema Port. This are the few strategies that we think can help develop the Tema Port with the help of China through the "One belt One road" initiative:

a. Reduction fees of the port cost and charges: Tema port has one of the most expensive charges, the reduction of it will be good for attract a lot of shipper lines.

b. Creation of good logistics network: We can think about the construction of a logistic base where people will withdraw their products or deposit it to be sent outside Ghana via the Tema port without having to go to the port it will be good for the decongestive of the port.

c. Can we make Ghana profit from China through the "OBOR" initiative: the OBOR will boost the volume How trade of Ghana with others countries around the world? The development of Tema port will Ghana to be part at the emancipation of his strategy who will make him an important leader from the west Africa to Europe and China maritime routes, from there Ghana will get more revenues which will be good for the domestic economy and will help to create a lot of jobs and public infrastructures for the population.

CONCLUSION

Cooperation between China and Ghana is very beneficial to the two countries. The paper has shown us that the "one belt one road" strategy is important for the development of the Tema port. The results obtained after using the gravity model are showing us that there is an immense trade potential between China and Ghana. One of the factors affecting the trade between them are the GDP and the population, the population has an impact on the import resulting to the volume consumption and the market growing, the export part decides the quantity and quality of the labor force. The GDP has an essential role in the purchasing power of the citizens of the country. We can see that the more Ghana importing from China it will help increase the trade volume, and as the result, in the next few years, the trade value export between China and Ghana will be growing more and more. The China "OBOR" strategy will be a positive help for the Tema port development and will also help it strengthen his power in West Africa. The proposed suggestions in this article are used can help develop the Tema port and can also ameliorate a fluidity movement and ameliorate the supply chain for the neighbors and others

countries they can from the Tema port send and receive goods which will also good for the Ghana economy

Although this research provides significant outcome on the of the OBOR strategy towards West Africa countries, further in deep studies are required to assess the port efficiency as their impact on the bilateral potential trade between West Africa countries and China. Therefore, it would be imperative to forecasting and modeling the effect of the OBOR strategy and west Africa port container throughput.

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