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– A Gravity Model Approach

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Abstract

A Gravity approach has been undertaken to investigate the determinants of China's agricultural imports from Sub-Saharan African (SSA) countries using panel data covering the period 1995-2014. China's agricultural import has increased significantly during the period and the agricultural export for the SSA countries is vital for their development. The empirical results show that the GDP of China, the GDP of the SSA country and the infrastructure, the institutional quality and the natural resource endowments within the SSA country and trade arrangements are significantly and positively impacting China's agricultural imports from SSA. The transportation cost is a weakening factor.

1. Table of Contents

1. Introduction

1.1 Trade and food security

Agricultural trade immediately affects food production, prices, employment and government revenues. In the longer run, it also affects competitiveness, infrastructure development, and the development of marketing channels and distribution networks, as it affects the incentives for public and private investments and new players' entry into markets. These effects can be divided into three categories, total food supply (e.g. production, net trade and stocks), household income (e.g. farm income, employment and wages) and government services (e.g. food safety, health and education). The agriculture is essential for food security. (FAO 2016)

Many emerging economies are facing challenges with food security. According to the Food and Agriculture Organization of the United Nations (FAO), *"Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life"* (FAO 2006). The definition points out the four pillars of food security; availability (the availability of sufficient quantities of appropriate quality); access (individuals own access to adequate resources for acquiring appropriate food for a nutritious diet); utilization (utilization of food through adequate diet, clean water, sanitation and health care to reach nutritional well-being); stability (i.e. one should not risk of losing access to food because of e.g. sudden shocks). Food security does not distinguish whether the food is produced domestically or imported, and trade is for many countries essential for food security. However, the links between trade and food security are inherently complex. There is no panacea for improved food security. The way trade is connected to each of the pillars is very context specific, it depends e.g. on the characteristics of the country, level of development, competitiveness of the agricultural sector, functionality of the markets, degree of urbanisation, and the way government intervenes in the market. (FAO 2016)

The debate on whether trade is contributing to increased food security worldwide has been a watershed for a long time (Clapp 2014, Clapp 2015, Farsund et al 2015). Advocates for trade having a negative impact on food security prioritize locally produced food to enhance availability, access, nutrition and stability (Clapp 2015). However, food security itself does not distinguish between locally produced or imported food (FAO 2016). Food security can be accomplished by trade, i.e. through the movement of food across borders. Idsardi (2010) for e.g. argues that South Africa, being a net food exporter, can contribute to food security in its export markets, without compromising domestic food security. The level of food security can also increase in the exporting country through agricultural trade (Clapp 2014). Advocates for trade liberalisation increasing food security, claim that open markets promote more efficient agricultural production, which will gain all parties due to an increase in global food supply and lower food prices (Clapp 2014). While countries trade, they specialise in the products they have a comparative advantage in, and the production gets more efficient (trade theories dealing with comparative advantages are presented in ‘2. Conceptual Framework’). The efficiency gains will increase the global food supply and all countries should receive a greater share of the supply. According to the forces of demand and supply, a higher supply will generate lower prices, i.e. food prices in the case of agricultural trade. The lower food prices will lead to that food will be more accessible for the poor and hence, improve food security, in the trading countries. Also, the efficiency gains within the agricultural sector in the export countries ought to increase economic growth. This will lead to more job opportunities and greater incomes, which in turn will make food yet more accessible. (Clapp 2014)

The economy of many Sub-Saharan African (SSA) countries, where the agricultural sector is large, might be significantly affected by small changes in the world prices of agricultural commodities (FAO 2015). Agricultural protection policies are thereby a potential threat to food security, according to World Trade Organisation, the World Bank (Clapp 2014) and FAO (2015). Trade policies always affect prices and increased food prices will endanger poor people’s access to food. FAO encourages countries to pursue their national objective, while doing no harm to their trading partner, i.e. not to disrupt global markets and create difficulties for other countries to achieve their food security objectives by using certain trade policies (FAO 2015). Hence, trade is essential in achieving food security worldwide.

Trade is not only vital in achieving food security but also, important for economic growth. For emerging economies, trade boosts development and reduces poverty and growth occurs through increased commercial opportunities and investments (EU 2017). Trade also boosts competitiveness and increases the value of a country’s products due to lower costs of inputs because of increased competition. Emerging economies gain access to new markets and materials by trade, which enables new production possibilities and hence export diversification. Also, trade facilitates exchange of know-how, technology and investment in research and development (EU 2017). The trade between the emerging economies in SSA and China has increased remarkably the past decades (see Figure 1).

1.2 Sub-Saharan Africa and China

China has experienced a tremendous gross domestic product (GDP) growth during the past decades (see Figure 1), and has emerged as one of the largest single players in the global market of investments, aid and trade. The major difference between, for e.g. the EU's and China's approach to investments and trade could be derived from China's 'non-interference principle', which implies that a country shall not interfere in other countries' internal affairs (Zheng 2016). This principle dates to the early 1950 and is a fundamental principle of their foreign affairs. The principle can be one explanation for China to trade more with countries with lower institutional quality (De Grauwe et al 2012, Hu & van Marrewijk 2013).

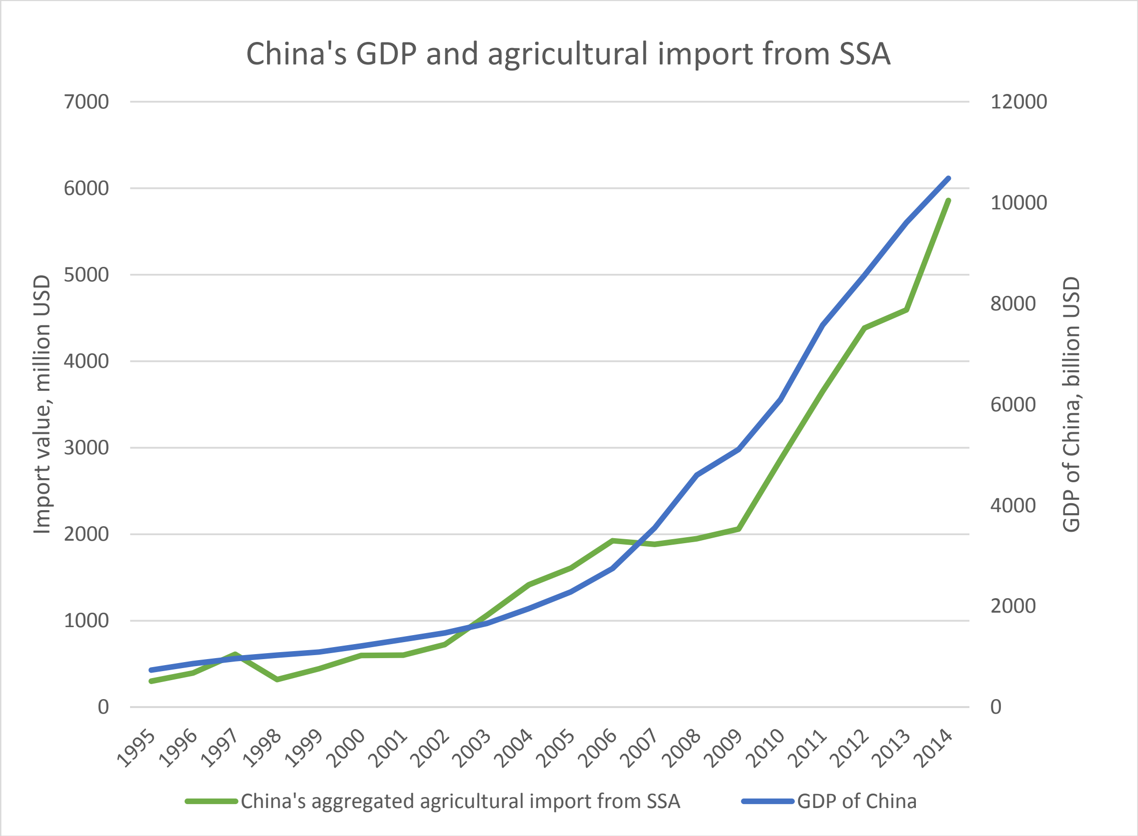

Figure 1. China's agricultural import from SSA, and GDP, 1995 – 2014. Source: WITS, World Integrated Trade Solution (2017).

The Forum on China-Africa Cooperation (FOCAC) was established in 2000 to strengthen consultation, expand cooperation and promote political dialogue and economic cooperation between China and African countries. In 2001, China adopted the so-called 'going out'-strategy, to encourage the outward economic development, one of the objectives was to ensure domestic food security (Lei Sun 2011). During the second ministerial conference of

FOCAC in December 2003 in Addis Ababa, Ethiopia, the Addis Ababa Action Plan was adopted. The agreement was an overall plan for China-Africa cooperation in political, economic and social development fields. Among other steps, it was decided to open the market between China and Africa (FOCAC 2017).

China's presence in Africa is today widespread. The impact and the determinants of Chinese foreign direct investments (FDI) in Africa has been explored broadly (Sanfilippo 2010, Kolstad & Wiig 2011, Abdul-Hameed Abdullahi 2013, Zhang et al 2013, Ross 2015, Busse et al 2016). Chinas FDI in SSA has increased significantly during the past decade, from $200 million in 2000 to $2.9 billion in 2011 (Busse et al 2016). Several empirical works show that Chinese FDI in Africa is attracted to countries endowed with natural resources (Breivik 2014, Kolstad & Wiig 2011, Busse et al 2016, Ross 2015). Natural resource abundance is also a determinant for China's trade with Africa (Biggeri & Sanfilippo 2009, Eisenman 2012). Additionally, the impact of Chinese aid in Africa has been investigated (McCormick 2008, Busse et al 2016). The determinants for Chinese agricultural import from Africa has been investigated to a limited extent. Zhang et al (2010) tested the determinants and potential of China-Africa agricultural trade by using the Gravity model, showing that population size and real GDP have a positive and significant impact on the agricultural trade. Idsardi (2010) uses a Gravity model in his attempt to identify the determinants of agricultural export growth in South Africa. Like the results of Zhang et al (2010), the results of Idsardi (2010) shows that GDP of the exporting country and the population size positively and significantly affects agricultural export. Tesfaye (2014) tested the determinants of agricultural export in Sub-Saharan Africa based on panel data by a fixed effect estimation technique, nevertheless, not solely exports to China. The results of Tesfaye (2014) state that the agricultural input use and, in accordance with previous studies, real GDP of the exporting country, positively and significantly affects agricultural exports of SSA countries. Hence, the variations in the variables that have been tested as determinants for agricultural trade between China and SSA is limited.

During the period of this study, 1995 – 2014, China's aggregated agricultural import from SSA increased a little over twenty times (see Figure 1). The increase in their agricultural import took up speed after China's adoption of its 'going-out'-strategy in 2001 and right after the Addis Ababa Action Plan was adopted in 2003. As seen in Figure 1 the trend for the GDP of China is very similar to that of its agricultural import from SSA. If the GDP of China continues to grow there will be a great potential for SSA to continue to increase their agricultural export to China.

The problems of SSA countries concerning their agricultural sector are several and complex, they suffer from vulnerability due to weather-related shocks and low yields due to technological backwardness and inadequate infrastructure. Also, HIV/Aids, malaria and tuberculosis have resulted in farm labour shortages, the rapid urbanization causes challenges for the rural areas to provide food for the populations in the cities. Finally, changed food habits, from drought resistant staples to water dependent staples are making the agriculture yet more vulnerability to weather-related shocks (FAO 2006). The agriculture sector serves vital functions in society. First, it provides essential food and second, it provides a livelihood for approximately 30 % of the worldwide workforce, in multiple African countries, up to 70 % of the workforce is engaged in the agriculture (Clapp 2015). Within Sub-Sahara Africa, many countries suffer from food insecurity. Since trade boosts a country's growth and that agricultural trade improve the country's food security, agricultural export can be a vital step for the SSA countries in their development.

Based on the fact that trade is beneficial for economic development and food security, it is of interest for the SSA countries to be aware of the determinants that historically have been attracting Chinese agricultural import. Thus, the African countries can develop an understanding of how to further attract Chinese agricultural import.

1.3 Objective and Research question

The objective of this thesis is to analyse the importance of certain factors determining China's import of agricultural and food commodities from SSA, by using a Gravity model approach. The Gravity model is today the workhorse of applied international trade literature, the model has been used in numerous papers to identify determinants for trade (Idsardi 2010, Zhang et al 2010, De Grauwe et al 2012, Adekunle & Gitau 2013). An augmented Gravity model will be used to analyse the importance of several factors for China's agricultural import from SSA. The base for this paper is twofold, first, it assumes that trade is a vital contribution to for an emerging economy's growth, and second, that trade is one of the main keys in accomplishing the Sustainable Development Goals, SDG, and especially goal number two – 'zero hunger', i.e. achieve food security. The research question that will be answered by this study is as follows: *What are the Determinants of China's Agricultural Imports from Sub-Saharan African countries?* The set of determinants and hypotheses that have been tested are presented in the section '3.2 Variable selection'.

The contribution of this study is to add to the literature concerning the relations between China and the SSA countries, but mainly, to develop an understanding of the relationship between certain factors and China’s agricultural imports from SSA, which will help SSA policy makers and exporters to attract Chinese agricultural import. Today, the literature on the determinants of China’s agricultural imports from SSA is limited. While previous studies (Zhang et al 2010, Idsardi 2010, Tesfaye 2014) show that GDP of the exporting country is significant, this thesis will test a set of eight variables to develop a thorough understanding of China’s agricultural imports from SSA. The increased export is assumed to benefit SSA countries through a higher level of food security and economic growth.

1.4 Disposition

This study is divided into five main sections. The first section, ‘1. Introduction’, includes the background and previous literature concerning the relations between trade and food security, the importance of trade for emerging economies, and the relation between China and SSA is introduced. In the second section, ‘2. Conceptual Framework’, basic trade theories and the Gravity model are presented, and previous literature on the Gravity model. The third section, ‘3. Methodology and Data’, focuses on the model specification, the choice of variables to test as determinants, based on previous literature, and the sources of the data. The fourth section, ‘4. Results and Discussion’, provides and analyses the empirical results and raise potential limitations. The fifth and final section, ‘5. Summary and Conclusion’, summarize the study.

2. Conceptual framework

There are multiple theories trying to explain why trade exists. Two of the most famous are the Ricardian model and the Heckscher-Ohlin, HO, model, which dates back to 1930's. The HO model is built on the Ricardian model, which dates to early 1800 (W. Koo & Lynn Kennedy 2005). The Ricardian model depends on productivity differences and assumes two countries, two products (homogeneous across countries) and one single input, e.g. labour, while the settling component is the countries' comparative advantages. Thus, the Ricardian model states that a key determinant for trade is the relative labour inputs used to produce commodities. The simple version of the HO model relies on two countries, two products (homogeneous across countries) and two inputs, e.g. capital and labour. The capital abundant country has a comparative advantage in producing the capital intensive product, while the labour abundant country has a comparative advantage in producing the labour intensive product. Hence, the HO model states that comparative advantage is explained by differences in resource endowments. Both the Ricardian model and the HO model states that the countries will specialise and produce, and hence export, the product in which they have a comparative advantage, and import the other product. This specialisation trigger competition and leads to production efficiencies, a greater supply, lower prices and economic growth. (W. Koo & Lynn Kennedy 2005)

The HO and the Ricardian models present the fundamental reason for trade, i.e. the advantages in specialising, however, they are not able to identify further determinants for trade. Also, the reality is far more complex than the simplification the models are based upon. In reality, the preferences differ across individuals and borders, which the models do not consider, while assuming homogenous products. When products are assumed to be heterogeneous, another approach can be undertaken, e.g. by using the Armington model, which (Sarker & Surry 2006). The Ricardian and HO models provide an important and intuitive understanding for trade and explain the advantages. But the Gravity model however, can test and identify determinants for trade and hence provide a further understanding on how to increase the trade.

2.1 The Gravity model

Sir Isaac Newton's Universal Law of Gravitation states that the strength of the force between two massive objects depends upon their respective masses and the distance between the objects. The law revolutionized the science of physics and has been applied even in social science. Back in 1889 the model was applied to explain migration flows within the UK (Ravenstein 1889). Tinbergen (1962) and Pöyhönen (1963) extended the area of use and were the first ones to use the Gravity model to explain economic interaction. Several researchers have justified the model since the mid 1970's, since the model was criticized for lacking theoretical support. The first attempt to derive the model from a theoretical framework was done by deriving the Gravity equation assuming product differentiation (Anderson 1979). The Gravity equation has been derived assuming monopolistic competition for the purpose of exploring the determinants of bilateral trade (Bergstrand 1985, 1989). Also, a differentiated product framework with increasing returns to scale has been used to justify the model (Helpman 1987). Finally, the Gravity equation has been justified by standard trade theories (Deardorff 1998). The model has from then on been used to explain e.g. foreign direct investments (Bergstrand & Egger 2007, Head & Ries 2008) and international trade flows (Martinez-Zarzoso 2003, Abu Hatab 2017). The model has mostly been used to explain trade in goods but has additionally been applied successfully to trade in services (Kimura & Lee 2006). Also, the Gravity model has been used to calculate export potential (Zhang et al 2010). The extensive field of application has contributed to the Gravity model being a popular model in the empirical modelling of trade flows between countries.

More recently critique that has been discussed is the Gravity model's neglect of supply side constraints, such as weather conditions and pests, as a potential limitation of the model (Idsardi 2010). E.g. weather condition is highly important for the function of the agricultural sector. Another limitation with the Gravity model is that it does not cover the effects of e.g. trade creation and trade diversion, i.e. changes in trade between a country pair when one of the countries enters a preferential trade agreement with yet another country or union. I.e. if either China or any of the included SSA countries were to enter a preferential trade agreement with a third part, this will most likely have an impact on the trade between China and the SSA country. However, the Gravity model is not able to capture this. Also, if equal decreases in trade costs across all routes occur, a problem arises. Equal decreases in trade costs might be due to e.g. a fall in oil prices, then transport costs lower, both domestically and internationally. The basic Gravity model would suggest proportional increases in trade across all bilateral routes, including domestic ones. However, the consumption pattern is assumed to remain constant since the relative prices are unchanged. (Shepherd 2012)

The greatest advantage with the Gravity model is most likely that it is an intuitive and convenient model which provides results that are easy to interpret. This is most likely the reason why the model continues to be the workhorse within the applied international trade literature.

3. Methodology and Data

3.1 Model specification and how to estimate

As presented, the Gravity model explains the economic flow between two countries by their respectively GDP and the geographical distance. Intuitively, larger country pairs are expected to trade more, while we expect countries further apart to trade less, due to higher transportation costs. Trade is assumed to be decided upon the country's GDP, i.e. the country's economic mass, and the transportation cost, i.e. the distance in between is used as an observable proxy for transportation costs. Idsardi (2010) has proposed that distance can be a proxy for several measures, such as transport cost, transaction cost, shipping times and cultural differences, which may impede trade due to differences in preferences, values, language etc. These can be categorized as trades costs. The initial version of the Gravity model can be expressed as:

$$X_{ei} = C\,\frac{GDP_e^{\beta_1}GDP_i^{\beta_2}}{DIST_{ei}}\eta_{ei} \qquad (1)$$

X_{ei} denotes the trade between country e (export country) and i (import country); GDP denotes the countries' GDP, respectively; DIST represents the distance between the two countries; η_{ei} denotes an error term. If the variables are used in their natural log form, the estimation procedure can be conducted.

$$lnX_{ei} = \beta_0 + \beta_1 lnGDP_e + \beta_2 lnGDP_i + \beta_3 lnDIST_{ei} + \eta_{ei} \qquad (2)$$

For simplification, $logC = \beta_0$. The model can be adjusted and extended to include other variables to control for, which are assumed to have an impact on trade, such as institutional characteristics, access to sea, common language, natural resource endowments, etc.. In this study, an augmented Gravity model is used since additional independent variables will be included to develop a more thorough understanding of the Chinese agricultural import from SSA. See the section '3.2 Variable selection' for a discussion of the selected variables.

The econometric problem is to estimate the unknown parameters (i.e. β_0, β_1, β_2, and β_3 in equation (2)). This is done by a multiple regression model. When the countries are treated as a region, and the study does not cover individual country effects, a pooled ordinary least squares (OLS) approach can be undertaken. OLS is a method minimizing the sum of squared errors and gives the unknown parameter statistical properties. Expected outcomes for the variables can be set up in advance to test different hypothesis.

For each variable, the p-value provides an estimation of the null hypothesis, which is that the coefficient is equal to zero, i.e. does not affect the dependent variable. The by OLS estimated coefficients for the variables are interpreted in different ways, depending on whether the variables are in logarithms, or not. As will be described in the 'Variable selection' section, this study includes several dummy variables which are not able to use in log forms. In this study, the dependent variable is in its natural log form, while the dummies are in their natural forms and the quantitative independent variables, except one, are in logs. The reason for using the logs for the independent variables is due to the easy interpretation. The coefficient of a variable is estimating the effect on the dependent variable, that holds on average, while keeping the other independent variables constant. If both the dependent and the independent variable are in logs, the coefficient is interpreted as the percentage change in the dependent variable due to a one percentage change in the independent variable, i.e. the elasticity of the variable. While the dependent variable is in log form, and the independent variable is in its natural form, the coefficient is multiplied with 100 to get the percentage change in the dependent variable, due to a unit change in the independent variable. (Stock & Watson 2015)

3.2 Variable selection

To identify the importance of certain determinants for China's agricultural import from SSA countries a set of eight independent variables were identified based on the previous literature as follows.

$\mathbf{GDP_e}$ and $\mathbf{GDP_i}$ – GDP is measured in current US dollar (USD). Economic size was included in the original versions of the Gravity model by Tinbergen (1962) and Pöyhönen (1963). For the exporting countries, i.e., the African countries, the GDP ($\mathbf{GDP_e}$) is assumed to reflect the country's supply capacity (Idsardi 2010). For the importing country, i.e. China, the GDP ($\mathbf{GDP_i}$) is assumed to reflect the Chinese economic market size, i.e. a measure of the Chinese demand (Idsardi 2010). The traded volume is assumed to be greater, the greater the supply capacity and import demand. Hence, the expected sign of $\mathbf{GDP_e}$ and $\mathbf{GDP_i}$ is positive.

$\mathbf{Dist_{ei}}$ – The distance is measured in kilometres between Beijing and the capital cities of its trading partners in SSA. Like GDP, distance was included in the original versions of the Gravity model by Tinbergen (1962) and Pöyhönen (1963). The distance is assumed to be an observable proxy for the transport cost (Shepherd 2012, Hoarau & Didier 2014) and is assumed to be a weakened factor for trade. The expected sign of $\mathbf{Dist_{ij}}$ is negative.

$\mathbf{LL_e}$ –If a country is landlocked the country's ability to trade can be limited due to lack of given transport routes through domestic harbours. The variable landlocked has been tested as a determinant for trade in several studies (Limão & Venables 2001, Tesfaye 2014). The variable landlocked can, as well as the distance, capture transportation costs (Hu & van Marrewijk 2013). The variable is a dummy variable and zero indicates that the country is not landlocked, while one indicates that the country is landlocked. Due to the fact that trade might be negatively affected if the country is landlocked, cause of higher transportation cost, the expected sign of $\mathbf{LL_i}$ is negative.

$\mathbf{Infr_e}$ – this variable was included to capture the effect on infrastructure on trade between China and SSA. A decent infrastructure is highly important for transportation, commuting, tourism and not least trade. Infrastructure can be measured in several ways, e.g. by secure internet servers, rail lines, share of paved roads, price for gasoline and mobile cellular subscriptions. Several authors have used infrastructure as a determinant of trade between countries (e.g. Jordaan & Eita 2012, Tesfaye 2014). Studying the determinants for Chinese agricultural imports, a proper proxy for infrastructure would e.g. be the share of paved roads within the African countries due to the importance of proper transportation opportunities for the goods. However, due to unavailability of complete data for many SSA countries, the infrastructure has within this study been proxies by number of mobile cellular subscriptions per 100 persons. In many SSA countries, the mobile phones have revolutionised people's day-to-day life. Via mobile phones people can e.g. get access to weather forecasts and veterinary assistants, and transfer money. To be able to use the natural logarithms of the variable, the zero values have been replaced with a small number. Because a well-functioning infrastructure is expected to benefit trade, the expected sign of $\mathbf{INFR_e}$ is positive.

$\mathbf{InstQ_e}$ – this variable was included to measure the effect of institutional quality on trade between China and SSA. The institutional quality within the supply country might have an influence on the country's export. Several authors have used institutional quality as a determinant of trade between countries (e.g. Tesfaye 2014, Hu and van Marrewijk 2013). Within this study, control of corruption is used as a proxy for institutional quality in the exporting countries. Still, it is of importance to be aware that control of corruption is solely one way to measure institutional quality, for e.g. rule of law that WGI also provides an estimation for, is yet another way to measure institutional quality and governance. The estimation of the control of corruption ranges from approximately -2.5 to 2.5, where a higher value indicates better governance. Since the variable can take on negative values, the variable has been used in its natural form. The control of corruption started to measure by the year 1996, and until 2002 it was measured once every second year, therefore, the data has been slightly modified. For the year 1995, the value equals the estimation of 1996 for each observation, and for the year 1997, 1999 and 2001 the average of the estimations of the year before and after was used as an estimation. The expected sign of $\mathbf{CoC_e}$ is positive.

$\mathbf{NR_e}$ – Natural resources come in various forms and have been tested in multiple studies as determinants for the Chinese engagement in Africa (Biggeri & Sanfilippo 2009, Abdul-Hameed Abdullahi 2013, Didier & Hoarau 2014). Land is necessary for agricultural activities and considering the determinants for agricultural import, arable land, land capable of being ploughed and used to grow crops, is used as a proxy for natural resources within this study. The arable land is measured by hectares, ha, of arable land per person. The expected sign of $\mathbf{NR_e}$ is positive.

The variable ($\mathbf{FOCAC04_e}$) was introduced to capture the effect of the establishment of FOCAC in the agricultural exports from SSA to China. More recently, trade agreements and trade policies have been tested as determinants for trade in previous studies (Hu & van Marrewijk 2013, Abu Hatab 2017). However, since there are no trade agreements between China and SSA countries, FOCAC can be considered a proxy for trade agreements, nevertheless an indication of cooperation or favorable trade policies. During the second ministerial conference, December 2003 in Addis Ababa, Nigeria, the Addis Ababa Action Plan was adopted that mapped out an overall plan for China-Africa cooperation in political, economic and social development fields. Among other steps, it was decided to open the market and for China to provide zero tariff treatment to certain import from the least developed countries in Africa (FOCAC 2017). Hence, the dummy variable $\mathbf{FOCAC04_e}$ will be given the value one, indicating that the cooperation is ongoing, from the year 2004 and forward. Since the purpose of the forum is to, inter alia, further strengthen friendly cooperation, the expected sign of $\mathbf{FOCAC04_e}$ is positive.

Including the above-mentioned variables, the final augmented Gravity equation that will be used in identifying the importance of certain determinants for Chinese agricultural import from SSA countries is as follow.

$$lnIMPORT_{ei} = \beta_0 + \beta_1 lnGDP_e + \beta_2 lnGDP_i + \beta_3 lnDist_{ei} + \beta_4 LL_e + +\beta_5 lnInfr_e + \beta_6 InstQ_e + \beta_7 lnNR_e + \beta_8 FOCAC04_e + \eta_{ei} \qquad (3)$$

Where the dependent variable $\mathbf{IMPORT_{ei}}$ indicates the agricultural import from country e (a SSA country) to country i (China); the c term is a regression constant; the β terms are coefficients to be estimated and η_{ei} is a random error term.

3.3 Data and Data sources

While studying the determinants of China's imports, the dependent variable is the value of China's agricultural import from SSA countries. The included commodities are agricultural and food commodities based on Standard International Trade Classification (SITC) Revision 3 and considers the commodity groups 0 (food and live animals), 1 (beverages and tobacco) and 4 (animal oil/fruit/wax), and the subgroups 21 (fur/skin), 22 (oil seeds/oil fruits), 23 (crude/synthetic/rubber), 24 (cork and wood), 25 (pulp and waste paper), 26 (textile fibers) and 29 (crude animals/vegetable materials). The traded value is the aggregated value for all above mentioned groups, measured in million USD and is provided by World Integrated Trade Solution (WITS) and cover the period 1995-2014. The year 1995 was the first year and 2014 was the last year possible to include, to cover data for all the included variables. See Appendix 2 for descriptive statistics of the included variables.

For the classification of African countries being 'Sub-Saharan African' countries, the definition of the World Bank was adopted. Due to lack of complete data, for the trading values such as several of the independent variables, a set of 19 countries were excluded from the dataset. See Appendix I for a list of all the 48 SSA countries and which 29 of them were used for the econometric estimation. For some of the including countries data was not available for the entire period, i.e. 1995-2014. Thus, the cross-sectional units are 29 and the observations are 527. Hence, the average number of years covered for each country is 18 years.

Regarding the independent variables, the sources are multiple. Data on countries' GDP, number of mobile subscriptions and arable land, were collected from the World Development Indicators' (WDI) database, provided by the World Bank. Information on corruption was gathered from the Worldwide Governance Indicators database, WGI, database, conducted by Kaufmann, Kraay and Mastruzzi (2010). The distances between China and the African countries, and if the African countries are landlocked, were collected from the French research center in international economics (CEPII). Information about FOCAC was collected from the official website of the forum on the Internet. See Appendix 2 for descriptive statistics of the included variables.

Table 1. A summary of the variables included in the estimation.

Variable	Description	Proxy	Expected sign	Data source
$IMPORT_{ei}$	Dependent variable. The Chinese agricultural import from country e, measured in million USD	NA	NA	WITS
GDP_e	The gross domestic product of exporter	Supply capacity of exporter	+	WDI
GDP_i	The gross domestic product of China	Economic market size of China	+	WDI
$Dist_{ei}$	Distance in km between China and exporter	Trade cost	-	CEPII
LL_e	Whether the exporting country is landlocked	Transportation cost	-	CEPII
$Infr_e$	Mobile cellular subscriptions, per 100 persons	Infrastructure	+	WDI
$InstQ_e$	Control of corruption	Institutional quality	+	WGI
NR_e	Arable land, hectares per person	Natural resource	+	WDI
$FOCAC04_e$	Forum on China-Africa cooperation	Economic cooperation and trade arrangements	+	FOCACs' official website

4. Results and Discussion

4.1 Empirical results

The empirical results of the estimation are presented in Table 2. To test the validity of the model a variance inflation factor (VIF) test was conducted. The test checks for multicollinearity between the independent variables. If there is imperfect multicollinearity between two variables, i.e. two independent variables are highly correlated, at least one of the coefficients will be biased (Stock & Watson 2015). The results do not indicate any collinearity problems, which it does if the VIF-values are larger than ten (see Appendix II for the results). The r square and the adjusted r square is 41% and 40%, respectively.

Table 2. Estimation results.

Variable	Coefficient	Standard error	t-ratio	p-value	Significance level
Constant	-4.607	10.961	-0.420	0.675	
$lnGDP_e$	0.276	0.075	3.666	0.0003	***
$lnGDP_i$	0.693	0.204	3.403	0.0007	***
$lnDist_{ei}$	-1.888	0.980	-1.926	0.0547	*
LL_e	-0.919	0.242	-3.791	0.0002	***
$lnInfr_e$	0.119	0.034	3.455	0.0006	***
$InstQ_e$	0.335	0.165	2.037	0.0422	**
$lnNR_e$	1.274	0.226	5.631	<0.0001	***
$FOCAC04_e$	0.929	0.313	2.967	0.0031	***

*, ** and *** indicates a significance level of 90, 95 and 99 %, respectively. Number observations being used were 527 and 29 cross-sectional units, i.e. SSA countries. Dependent variable: Natural log of Chinese agricultural import (lnIMPORT), measured in million USD. Table 2 shows that all the variables are significant and have their expected sign.

4.2 Discussion of findings

The positive and significant, at 99 % level, coefficients for the GDP variables are in accordance with the expectations based upon theory and previous results when Gravity model is used for estimating determinants of SSA countries and South African trade (Jordaan and Eita 2012, Tesfaye 2014). Within this study, the GDP of the exporting SSA country, was assumed to reflect the supply capacity of the exporter, thus, the estimation confirms that a greater supply results in a greater export. A one percentage increase in the domestic GDP of a

SSA country is assumed to result in a 0.28 % increase in its agricultural export to China. While the GDP is important in attracting Chinese importers, it is also positively affected by export. I.e. a greater GDP is assumed to result in a larger export, while the export itself is resulting in an increase in GDP. Hence, the GDP is central for trade and economic growth. Meanwhile, the GDP of China was a measure for the economic market size of China, which the estimation confirms positively affect the agricultural import from SSA. If the GDP of China increases by one percent, the agricultural import is assumed to increase, according to the results, with 0.69 %. If the GDP growth of China will continue to increase, the agricultural sector and hence the economy in many SSA countries will potentially bloom and thereby even secure a higher level of food security.

As expected, the sign of distance is negative, indicating that a one percentage increase in distance would result in a decrease of the agricultural import by 1.89 %, statistically significant at 90 %. This is in accordance with the basic assumption of the Gravity model that distance is a weakening factor for trade between two countries. There is also support for distance being a weakening factor for trade between China and Africa (Hu and van Marrewijk 2013). Landlocked can also be a proxy for transportation cost, which this study at 99 % significant level can confirm is negatively affecting the agricultural import from SSA. A landlocked country is expected to trade 91.9 % less than a country with a sea border. The results are consistent with Babatunde (2009), studying the export performance in SSA, implying that distance has a negative impact on trade. Landlocked countries within SSA are, in accordance to the results of this study, experiencing challenges with their export to China. Hence, for the landlocked countries other variables are of great importance in their attempt to attract Chinese agricultural import. To increase the landlocked SSA countries export to China, improving the institutional quality can be of importance.

A one percentage increase in infrastructure will lead to a 0.12 % increase in the agricultural export to China. These results are consistent with previous studies (Limão & Venables 2001, Babatunde 2009). Also, a developed infrastructure can be assumed to have spillover effects to other sectors and enhance the local production capacity, which will have a positive impact on the economy’s’ growth (Hu & van Marrewijk 2013). The infrastructure was within this study measured as the mobile cellular subscriptions per 100 persons, which during the period subject of this study increased exponentially. In Kenya for e.g., the subscriptions increased by 16 000 times during the period. Thus, it might not accurately capture the effect of the infrastructure over time. The limited scope of this study does not allow a further exploration whether mobile subscriptions are an accurate variable representing the infrastructure for the SSA countries. Hence, it is of importance to be aware of that using mobile subscriptions as a proxy might bias the impact of infrastructure.

As expected, the sign of institutional quality is positive, indicating that one unit increase in the estimation of the country's institutional quality would result in an increase of 33.5 % in SSA agricultural export to China. However, it is worth highlighting that the estimation of the institutional quality, i.e. control of corruption, ranges between -2.5 – 2.5, thus, a one unit increase in the estimation is a large improvement. As can be seen in Figure 3, presenting an arbitrary small selection of SSA countries, the variable has hardly been changing one unit for any of the countries, during the period of the study. Nevertheless, any improvement in institutional quality is assumed to increase the agricultural import form China.

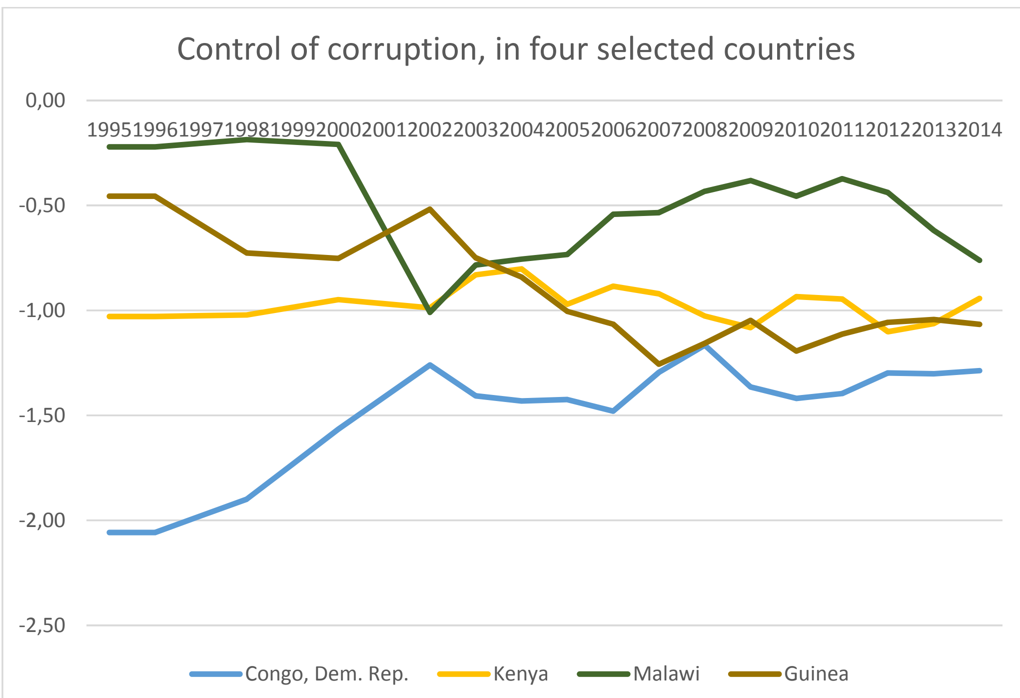

Figure 2. The control of corruption in some SSA countries, during the period subject of this study, 1995 – 2014. Source: Worldwide Governance Indicators (2017).

However, in contradiction to the results of this study, other studies have proven that China trades more with countries with lower institutional quality (De Grauwe et al 2012, Hu & van Marrewijk 2013). Hu and van Marrewijk (2013) used the 'Non-interference policy' as an explanation for China to trade more with countries with lower governance. Despite the wide support for China's engagement in SSA countries with a worse level of institutional quality, the estimation within this study states that a lower level of corruption, i.e. a better governance, is associated with a higher agricultural export to China. Tesfaye (2014), testing the determinants for agricultural export in SSA, explains that his insignificant coefficient of institutional quality indicates that institutions affect trade through their impact on other variables that determines trade flows, like investment and productivity. Which also Méon and Sekkat (2006) found support for. The variations in the result of institutional quality to be affecting trade or not, and in that case, positively or negatively, opens for the suggestion of further research on the subject.

The results show that one percentage increase in natural resources, will increase the agricultural export to China by 1.27 %, with a significance level of 99 %. Naturally, the greater area of arable land, the greater is the possibility of a larger supply of agricultural commodities. The geographical area of land is constant, but since the population and the use of land might fluctuate the variable used for natural resources, ha arable land per person, can vary. What is likely in this aspect to have an impact on trade is how efficient the land is used. When the land is being used more efficiently with respect to the choice of crop, labour and capital inputs, the more can be produced and hence exported. It would therefore be interesting to study the effect of the productivity in the agricultural sector as a potential determinant for agricultural export. This study can solely confirm that the more natural resources, the more trade. China's involvement in resource abundant countries, can be explained by resource-seeking motives, which has been discussed by e.g. Hu and van Marrewijk (2013) and De Grauwe et al (2012).

The significant, at 99 % level, coefficient for FOCAC of 0.929 confirms that the forum provides a strengthened friendly cooperation and hence an increase in Chinese agricultural import from SSA. On average, the establishment of the Addis Ababa Action Plan by FOCAC contributed to a 92.9 % increase in the traded value. Hu and van Marrewijk (2013) testing the implications of the Economic and Trade Cooperation Zones, ETCZ, confirms that the zones positively affect trade flows between China and the SSA host country. Hence, cooperation, either in form of FOCAC or within the ETCZ is positively affecting trade flows from SSA to China. This highly contribution of FOCAC to the traded value proves for African policy makers the importance of future cooperation, and can be an argument for entering a preferential trade agreement (PTA) with China, to encourage further trade.

The adjusted r square, 0.403 proves that the included variables do have an impact on the traded value, however, the model is not able to explain the entire variation in the dependent variable, i.e. the traded value. First, the set of variables chosen for this study is too small to cover all possible determinants. Naturally, more variables affect the traded value. While studying trade, exchange rate can for e.g. be a vital determinant. Secondly, if the variables had been proxies by other estimations, another value of the r square might have been achieved.

4.3 Potential limitations

Out of 48 SSA countries, only 29 were included in the econometric estimation of this study, due to lack of or incomplete data. Access to data for the least developed countries is vital to conduct empirical estimations like the one of this study. Worldwide efforts are necessary for gathering, compile and provide open access for data over e.g. development indicators. Also, among the countries that due to lack of data had to be excluded from the data set, some are associated with a very low estimation of the control of corruption, such as Sudan and Somalia, which could bias the results.

For this study, the traded value between China and SSA was conducted from WITS. If there has been any Chinese agricultural import from SSA during the period subject of this study, that are not reported in WITS, the results might have been biased.

As previously mentioned, some of the proxies used for the independent variables might not be the accurate ones. Mobile cellular subscriptions e.g. is a modern way of estimating infrastructure but might not accurately capture the infrastructure level during the beginning of the period. While studying the agricultural sector, it could be interesting to proxy the infrastructure by e.g. access to electricity or paved roads instead of mobile cellular subscriptions. The same reasoning, i.e. the possible use of different proxies for one variable, is applicable for several of the independent variables. Hence, future research can test other proxies for the variables in trying to determine the true determinants for China's agricultural import from SSA.

For this study, the independent variables were identified based on the previous literature, but other factors might affect the agricultural import which this study does not capture. Thus, further research on the determinants for Chinese agricultural imports from SSA would be a valuable contribution to the existing literature about the China-Africa relation. More up to date research on the export potential of SSA countries to China would be an interesting addition to studying the determinants of export to China.

5. Summary and Conclusion

The base for this paper is twofold, first, it assumes that trade is a vital contribution for an emerging economy's growth, and second, that trade is one of the main keys in accomplishing the Sustainable Development Goals, SDG, and especially goal number two – 'zero hunger', i.e. achieve food security. The objective of this study was to analyse the importance of certain factors determining China's import of agricultural and food commodities from SSA. This was done by using a Gravity model approach, the model is today the workhorse of applied international trade literature. To answer the research question: *What are the determinants of China's agricultural imports from Sub-Saharan African countries?* a set of variables were tested by using panel data for the period 1995 – 2014. All the independent variables are statistically significant. The results show that the GDP of China, the GDP of the SSA country and the infrastructure, the institutional quality and the natural resource endowments within the SSA country and the FOCAC are positively impacting China's agricultural import from SSA. This while the distance between Beijing and the capital of the SSA country and if the SSA country is landlocked are weakening factors for China's agricultural import. The results for some of the variables are in accordance with previous studies, while the results for some variables provide new evidence for being important in the Chinese import-decisions.

To secure the significance of the results within this study, future research should be conducted. Within this study different estimations and indicators have been used as proxies for variables to test. But in reality, institutional quality covers far more than an estimation of the control of corruption; mobile cellular subscriptions is only one way to measure infrastructure, for e.g.. Also, the r square of the empirical estimation implies that the variance of the dependent variable is explained up to 42 % by the included independent variables. Finally, only a set of 29 out of the 48 SSA countries were used in the econometric estimation. Hence, future research within this area, that might use other models and other variables, or other proxies, and that succeed to include more countries, would be an important contribution to the literature.

In the meanwhile, the results of this study can help SSA countries to attract China's agricultural importers, which can be done by e.g. improving its infrastructure or the institutional quality. While the FOCAC, used as a proxy for economic cooperation and trade arrangements, stating that the cooperation increased the traded value by 92.9% on average, it highlights the importance of trade agreements between China and SSA. With this result, SSA policy makers are encouraged to negotiate with China about entering a PTA on agricultural and food commodities. A PTA on agricultural and food commodities would most likely increase the agricultural trade between the parties.

For the SSA countries, their agricultural export to China can be a valuable contribution to the countries’ growth. The understanding of the results of this study and those of future research will hopefully contribute to a boost within the SSA countries agricultural export to China and thereby increase the countries’ economic growth and food security.

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Appendix

Appendix I: SSA countries

Table 3. A list of, by the World Bank defined, Sub-Saharan African countries, and which are included in the empirical estimation. 29 out of 48 countries are included.

SSA countries according to the WB	Included in the econometric estimation
Angola	YES
Benin	YES
Botswana	NO
Burkina Faso	YES
Burundi	NO
Cabo Verde	NO
Cameroon	YES
Central African Republic	YES
Chad	YES
Comoros	NO
Congo, Dem. Rep.	YES
Congo, Rep.	YES
Côte d'Ivoire	YES
Equatorial Guinea	NO
Eritrea	NO
Ethiopia	YES
Gabon	YES
Gambia	NO
Ghana	YES
Guinea	YES
Guinea-Bissau	NO
Kenya	YES
Lesotho	NO
Liberia	YES
Madagascar	YES
Malawi	YES
Mali	YES

Mauritania	YES
Mauritius	YES
Mozambique	YES
Namibia	YES
Niger	NO
Nigeria	YES
Rwanda	NO
Sao Tome and Principe	NO
Senegal	YES
Seychelles	NO
Sierra Leone	NO
Somalia	NO
South Africa	YES
South Sudan	NO
Sudan	NO
Swaziland	NO
Tanzania	YES
Togolese	YES
Uganda	YES
Zambia	YES
Zimbabwe	NO

Appendix II: Summary statistics and VIF

Table 4. Descriptive statistics over variables used in the estimation.

Variable	Mean	Median	Minimum	Maximum	Standard Deviation
IMPORT	57,70562815	13,830866	0,000119	1005,393823	103,3620873
GDPe	26535101398	8312078525	416000000	5,46682E+11	67359823711
GDPi	3,84913E+12	2,28597E+12	7,34548E+11	1,04824E+13	3,13412E+12
Dist	11011,01998	11347,11	8315,988	12651,77	1126,978064
LL	0,261859583	0	0	1	0,440064326
Infr	27,82313836	11,83389774	0	171,375053	34,86635397
InstQ	-0,64115388	-0,71669033	-2,05745840	0,760919094	0,509362546
NR	0,251581142	0,238065695	0,059479719	0,578564919	0,105076159
FOCAC04	0,588235294	1	0	1	0,492620561

Table 5. Variance Inflation Factors test-values

Variable	Value
lnGDPe	1.360
lnGDPi	4.585
lnDist	1.674
LL	1.726
lnInfr	2.625
InstQ	1.066
lnNR	1.563
FOCAC04	3.607