

# The impacts of China's economic policies on Sino-African agricultural trade: evidence from the gravity model analysis <sup>\*</sup>

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The rapid economic growth of China and some African countries provides tremendous opportunity for the agricultural trade. Both China and African countries have made great efforts in achieving win-win cooperation between the two economies. This paper aims to provide a comprehensive analysis of impacts of various factors on bilateral agricultural trade between China and Africa. The fixed effect Gravity model is adopted in the study to assess the impacts of different factors on Sino-African bilateral agricultural trade, based on the various data sets covering 1992-2010. The economic growth and rising agricultural production are found to be the two key factors to drive Sino-African future bilateral agricultural trade. Therefore, the focus should be put on the long-run effects of investment in promoting bilateral agricultural trade. Moreover, the agricultural cooperation should be enhanced to improve the agricultural production and fully use the comparative advantages in both sides.

**Keywords:** Sino-African agricultural trade, influencing factor, gravity model

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## 1. Introduction

China's rapid economic growth offers a great opportunity to boost economic development in Africa. This led to the exponential growth of Sino-African trade and investment over the past decades. For example, in 2012 trade between China and Africa reached US\$ 198.49 billion and China's accumulative Foreign Direct Investment (FDI) flows to Africa mounted to US\$ 21.23 billion (Information Office of the State Council, 2013). As a result, China has become Africa's largest trade partner, and Africa is now China's major import source, second largest overseas construction market and fourth largest investment destination (Information Office of the State Council, 2013).

Sino-African economic and trade development has not only improved people's livelihood and diversified economic development in Africa, but also provided strong support for China's socio-economic development (Schiere, 2011). Moreover, agricultural trade, as part of Sino-African economic and trade development, has attracted concerns of food security and economic development both regionally and internationally. Chinese agriculture engagement in the African continent is growing rapidly and having an increasing impact on African development and

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agrarian change. Therefore, this paper aims to investigate the Chinese policies' impacts on Sino-African agricultural trade. Before doing so, it is relevant and beneficial to look at the historical development of Sino-African economic and trade relationship in general.

### *1.1. Development of Sino-African economic and trade relationship*

China's earlier engagement with Africa can be traced back to the 15th century when Chinese traders visited East Africa (Schiere, 2011). However, the modern Sino-African economic and trade relationship was built mainly in the post-colonial period. Four main phases are discernible in this development since the formation of the People's Republic of China (PRC) in 1949. Review and comment upon the phases will be delivered in the following sessions.

#### *1.1.1. Establishment and preliminary development (1949-1978)*

China enlarged its cooperation framework with Africa, as part of its efforts to demonstrate solidarity with developing countries between 1949 and 1978 (Information Office of the State Council, 2010). However, most African countries haven't gain independence, when PRC was founded in 1949. At that time, only few countries, such as Egypt and Morocco traded with China. In 1960, 17 African countries including Nigeria and Senegal gained independence, increasing the total number of independent African countries to 26. Meanwhile, Sino-African trade first reached US\$ 100 million mark, with US\$ 33.84 million of exports and US\$ 76.73 million of imports by China (Information Office of the State Council, 2010). In the 1970s, China financed several showcase projects, such as Tanzania-Zambia railways, football stadiums and public buildings, which were largely driven by ideological interests.

#### *1.1.2. Adjustment and development (1979-1989)*

On the one hand, China began its economic reforms, giving top priority to economic development in 1978. China's industrialization and modernization processes provided opportunities to Chinese enterprises to do business with Africa. On the other hand, most African countries started to develop their economies and engage in international cooperation at the same time. In 1983, the Chinese government put forward the principles of equality, mutual benefit, efficiency, diversity and mutual development for the economic and technical cooperation with Africa. As a consequence, both Chinese and African businesses started to invest each other, besides the rapid growth of Sino-African trade. Sino-African economic and trade relationship became commercialized rather than ideological interest driven, since China's economic reforms led by Deng Xiaoping in 1978.

#### *1.1.3. Steady development (1990-1999)*

In the 1990s, China started the reforms in international trade and took multiple measures to promote trade between China and Africa. Also, China increased its FDI to Africa supported by the government's Going Global Strategy, such as providing soft loans and other assistance to African investment projects, aiming to help Chinese enterprises in becoming global multinationals. For example, Chinese banks have been increasingly involved in providing financial services to facilitate trade and investment projects in Africa during this period. The complementarities

between China and Africa came into full play, thus deepening trade and economic relations between the two sides in 1999 (Information Office of the State Council, 2010).

#### 1.1.4. Rapid development (2000 till now)

Driven by mutual desires to further strengthen Sino-African consultation and cooperation, China and African countries created the Forum on China-Africa Cooperation (FOCAC) and held the first Ministerial Conference under the FOCAC framework in Beijing in 2000. Since then, trade and economic cooperation between China and Africa experienced an overall expansion, and Africa became a popular destination for China's trade and investment.

Under the framework of FOCAC, Chinese government launched important measures to facilitate cooperation with Africa countries, covering a broad spectrum of areas, such as debt relief and zero-tariff treatment, further development assistance, investment promotion, concessional loans, medical care and public health, science and technology, and human resources. As a result, from 2000 to 2012, trade between China and Africa rose from US\$ 10.6 billion to US\$ 198.49 billion; China's investment in Africa increased from US\$ 220 million to US\$ 2.52 billion (Information Office of the State Council, 2010, 2013).

Over the past six decades, changes in the scope and level of Sino-African cooperation have yielded economic and social benefits, which helped the two sides to pursue common development efforts and realize the United Nations' Millennium Development Goals (MDGs).

### 1.2. China's preferential policies for African countries

China launched a series of trade facilitation measures, to expand China's imports from Africa in the past few decades. According to Information Office of the State Council (2013), all of the Least Developed Countries (LDC) in Africa that have established diplomatic ties with China enjoy zero-tariff treatment for 60% of their exports to China, covering 4,762 items. For example, China have signed agreements on trade, economic and technical cooperation with 45 African countries, agreements on bilateral promotion and protection of investment with 31 nations, and agreements on the avoidance of double taxation with 10 nations by the end of 2009 (Information Office of the State Council, 2010). Thanks to this policy, African exports to China have grown rapidly, reaching US\$113.17 billion in 2012 (Information Office of the State Council, 2013).

Moreover, African commodities exhibitions were organized in China, reducing or exempting both fees and domestic freight charges for African exhibitors. In addition, Chinese trade missions went to Africa to help increase African exports to China. Also, training programs were developed for African inspection and quarantine officials to promote Sino-African cooperation on quality control. With a view to facilitating balanced trade between the two sides, China also promoted air travel, ocean shipping, financial and tourism services, and encourage Chinese citizens to visit African countries. Furthermore, China established bilateral joint/mixed committees on trade and economic cooperation with African nations (Information Office of the State Council, 2010, 2013).

Consequently, African exports have increased in both variety and quantity. For example, Africa's chief exports to China used to be cotton, phosphates and other primary products. However, energy and mineral products have, recently, become the main exports from Africa to China,

whereas oil exports have also risen continuously, accounting for 13% of all Africa oil exports in 2012 (Information Office of the State Council, 2010, 2013). Likewise, textiles, garments, machine parts, base metals and woodwork, have also begun to enter the Chinese market, stimulated by China's preferential policies. Some specific products, such as South African wine, Ghanaian cocoa beans, Ugandan coffee, Tunisian olive oil and Ethiopian sesame are gaining recognition and popularity among Chinese consumers (Information Office of the State Council, 2013).

### *1.3. Recent development of Sino-African agricultural trade*

The recent economic growth of China and Africa provided tremendous potentials for Sino-Africa agricultural trade and cooperation. For instance, many African countries have realized the essential role that agriculture plays in securing food supply, eradicating poverty and achieving economic development since the global financial crisis (GFC) in 2008, therefore, Africa has a huge demand for crop cultivation and agricultural product processing. Fortunately, China has both expertise and technology in these areas. Moreover, Chinese government has attached great importance to agricultural cooperation and trade with African countries. Clearly, both Africa and China can reap mutual benefits from agricultural cooperation.

As discussed previously, China has been engaged in African agriculture for more than six decades, and China's early engagement in Africa was mainly motivated by building recognition internationally. Activities were largely characterised by bilateral agreements and donation based aids to Africa (Tang, 2002). During China's Reform Period in the 1980s and 1990s, engagements in Africa took the form of science and techniques focused joint venture-supported grants (Bräutigam, 2011). In the early 2000s, following China's joining of the WTO and opening of FOCAC, the focus has shifted to support for Africa's economic liberalization and integration into the global agriculture commodity market, such as export-oriented production, experimentation with Special Economic Zones, exemptions from customs duties, large infrastructure projects, and Chinese FDI in Africa (Berthelemy, 2011). These engagements still include bilateral and aid-based approaches, but are increasingly characterized by multilateral and regional engagements (Buckley, 2013). Since then, Chinese government has taken a series of policies and steps to promote Sino-African agricultural cooperation and trade, based on the principles of "equality and mutual trust politically, mutual benefit and win-win economically, exchange and emulation culturally". As a result, the agricultural trade between China and Africa has increased fast in recent years (See Table 1).

Tariff reduction and investment (in Africa) increase are regarded as key drivers of Sino-African agricultural cooperation and trade (Berthelemy, 2011). With regard to tariff reduction, China emphasizes its role as a stable market for African exports and provides zero tariff imports of a wide range of agriculture goods from 45 LDC partners since 2005 (Berthelemy, 2011). At the same time, investment has increased rapidly, covering 49 African countries in a wide range of sectors by a diversity of actors including state owned enterprises, private enterprises and individuals (Buckley, 2011). Chinese investment in Africa can be classified as two categories: investment in human resource and investment in assets. As to investment in human resource, between 2000 and 2010, there were more than 30,000 people participating various exchange and

training programs, which covers over 20 areas, such as economy, public administration, animal husbandry and fishery, health, science and technology, environmental protection, and established 10 special agricultural technology demonstration centres in Africa (State Council Information Office, 2010). In respect of investment in assets, according to data released by Ministry of Commerce, China's direct investment to Africa was \$ 2.11 billion in 2010, accounting for 3.1% of China's total global investment. Investment in Africa was regarded as a crucial driver to promote Sino-African agricultural cooperation and trade (Zhong and Wang, 2010; Han, 2010; Yao, 2008).

Table 1

China's main trade partners in Africa and average trade flow (1992-2010)

| Rank                  | Importing Country | Values of agricultural import<br>(ten million US dollars) | Rank                  | Exporting country | Values of agricultural export<br>(ten million US dollars) |
|-----------------------|-------------------|-----------------------------------------------------------|-----------------------|-------------------|-----------------------------------------------------------|
| 1                     | Zimbabwe          | 173.6                                                     | 1                     | South Africa      | 168.9                                                     |
| 2                     | South Africa      | 110.3                                                     | 2                     | Morocco           | 159.7                                                     |
| 3                     | Ethiopia          | 75.7                                                      | 3                     | Egypt             | 120.0                                                     |
| 4                     | Benin             | 71.5                                                      | 4                     | Algeria           | 95.8                                                      |
| 5                     | Mali              | 65.7                                                      | 5                     | Nigeria           | 82.8                                                      |
| 6                     | Côte d'Ivoire     | 53.2                                                      | 6                     | Ghana             | 57.9                                                      |
| 7                     | Cameroon          | 52.1                                                      | 7                     | Libya             | 44.8                                                      |
| 8                     | Sudan             | 47.4                                                      | 8                     | Senegal           | 38.6                                                      |
| 9                     | Egypt             | 37.1                                                      | 9                     | Togo              | 37.1                                                      |
| 10                    | Ghana             | 32.0                                                      | 10                    | Mauritania        | 26.6                                                      |
| 11                    | Zambia            | 25.7                                                      | 11                    | Benin             | 24.4                                                      |
| 12                    | Togo              | 19.7                                                      | 12                    | Angola            | 23.4                                                      |
| 13                    | Senegal           | 15.1                                                      | 13                    | Tunisia           | 23.1                                                      |
| 14                    | Mozambique        | 13.9                                                      | 14                    | Mali              | 22.1                                                      |
| 15                    | Chad              | 10.4                                                      | 15                    | Mauritius         | 17.9                                                      |
| 16                    | Mauritius         | 10.0                                                      | 16                    | Sudan             | 17.8                                                      |
| 17                    | Morocco           | 8.4                                                       | 17                    | Guinea            | 16.1                                                      |
|                       |                   |                                                           | 18                    | Gambia            | 14.6                                                      |
|                       |                   |                                                           | 19                    | Kenya             | 11.7                                                      |
|                       |                   |                                                           | 20                    | Mozambique        | 7.3                                                       |
| Cumulative proportion |                   | 81.9%                                                     | Cumulative proportion |                   | 83.0%                                                     |

Source: Computed according to UNCOMTRADE database.

Although there have been massive efforts in strengthening bilateral agricultural trade and economic cooperation between China and Africa, there is little research to evaluate the effectiveness of these policies and the impacts on Sino-African agricultural trade. So far as we are aware, the only research analyzing key factors affecting Africa agricultural trade was done by Zhang and Xie (2010). In their study, "whether the African countries joining FOCAC" was used as a dummy variable in the gravity model, to evaluate FOCAC's impact on Sino-African

agricultural trade. They came to a conclusion that African countries joining FOCAC was conducive to the expansion of agricultural trade between China and Africa.

However, there is a variable selection problem in doing so. Given the complexity of the African countries, simply using “whether joining FOCAC” as a dummy variable, will cause bias in the regression. It is because that there are other uncontrolled factors, such as financial crisis, war, economic reforms and government change, also affecting the decision. When “whether joining FOCAC” was introduced as a dummy variable in the model, the regression results cannot reflect the actual impact of FOCAC precisely.

Moreover, with the rapid growth of economy in China and Africa, an in-depth analysis of factors contributing to the Sino-African agricultural trade is needed to answer a number of key questions of agricultural trade between China and Africa. For example, (1) have the policies implemented promoted bilateral agricultural trade? (2) What is the main driving force of Sino-African trade, policy, or internal economic development? (3) Will Sino-African bilateral agricultural trade be sustainable? The answers to these questions are central for evaluations and policy making. Therefore, this research aims to examine the impacts from various factors on Sino-African agricultural trade, to help with policy recommendations for Sino-African agricultural trade.

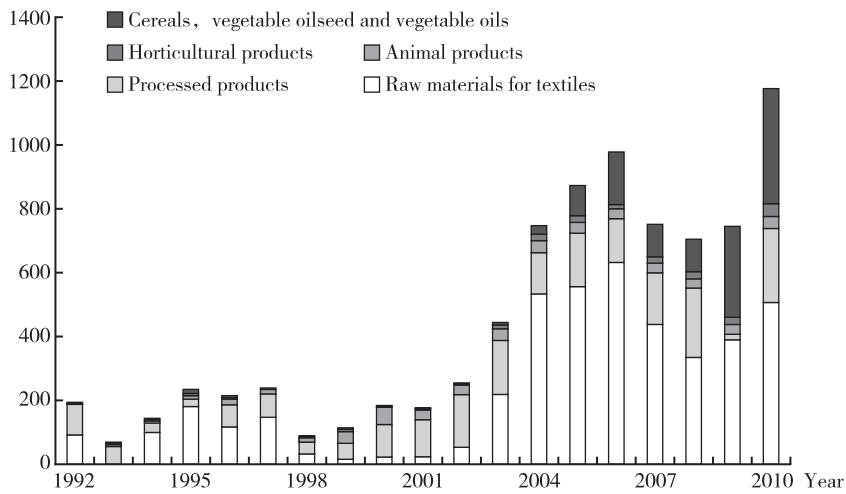
#### *1.4. Trends and characteristics of China Africa agricultural trade*

Chinese agriculture engagement in the African continent has grown rapidly and having an increasing impact on African development. Sino-African agricultural trade increased from US\$456 million to US\$2.519 billion between 2001 and 2010, an increase of 20.9% annually (UNCOMTRADE, 2010). During this period, China’s agricultural import from Africa increased from US\$175 million to US\$1.178 billion, with an average annual growth rate of 23.6%; China’s agricultural export to Africa increased steadily from US\$280 million to US\$1.341 billion, with an average annual growth rate of 19.0%.

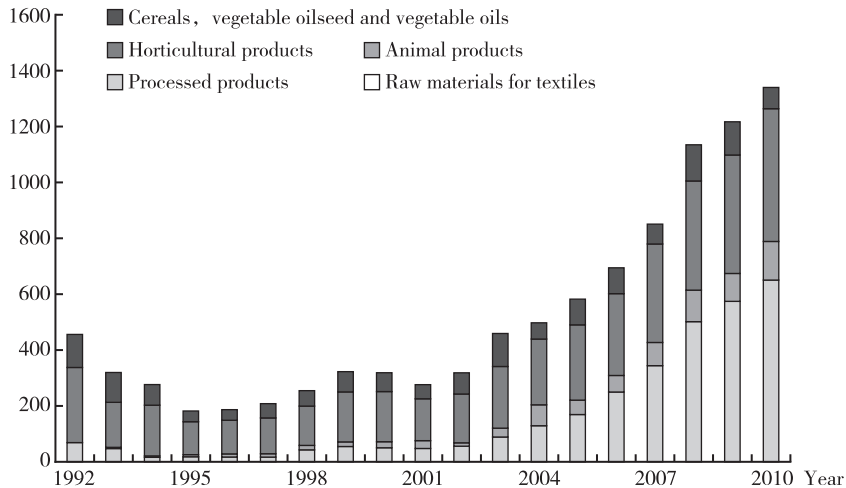
Despite rapid increases in Sino-African trade, however, African agricultural export to China focused on only a handful of products (Renard, 2011). China mainly imported textile raw materials and oil crops, guided by changing consumption patterns in China and increasing resource pressures (Buckley 2011). As shown in Figure 1, the textile raw material import (mostly cotton) increased from US\$ 20 million in 2001 to US\$ 500<sup>1</sup> million in 2010. In addition, oil crop import from Africa has increased to US\$ 360 million in 2010, although there was no import at all before 2003. Oil crop import made up of 30.7% of China’s total import value from Africa, an increase of 56.6% year on year. Among the oil crops imported, sesame dominated 92.2% of trade in 2010.

Compared with the import from Africa, China’s export was largely processed agricultural products and horticultural products. As shown in Figure 1, Chinese processed agricultural products export to Africa increased 12.1 times between 2001 and 2010 (UN COMTRADE, 2010). It accounted for 17.6% of China’s total agricultural export to Africa in 2001, and 48.4% of that in 2010. Meanwhile, China’s horticultural products export increased 2.2 times between 2001 and 2010 (UN COMTRADE, 2010). It made up 35.6% of China’s total agricultural export to Africa.

<sup>1</sup> It accounted for 42.8% of Chinese import values from Africa in 2010.



(a) China's import from Africa



(b) China's export to Africa

*Figure 1.* Changes of Sino-African agricultural product trade in 1992-2010 (US\$ million, 2000 constant price)

Source: UNCOMTRADE database.

China's import from Africa concentrated in a limited number of countries too. During the periods of 1992-1995, 1996-2000, 2001-2005, and 2006-2010, China's agricultural import value from its top five African exporting countries comprised 86.1%, 70.1%, 62.6%, and 57.5% of total agricultural import respectively. If calculated based on its top ten African exporting countries, the shares were 96.1%, 89.5%, 81.5%, and 79.8% respectively. Although recently the country concentration has been decreasing, still only several countries are leading African exporters to Chinese market.

Compared with import, China's agricultural export partners are relatively dispersed in Africa. During the periods of 1992-1995, 1996-2000, 2001-2005, and 2006-2010, for example, China's agricultural export to its top five African importing countries accounted for 59.3%, 63.2%, 65.4%, and 57.0%

respectively, of China's total agricultural export to Africa. If calculated based on its top ten African importing countries, the shares were 79.1%, 79.4%, 80.7%, and 75.9% respectively. It can be seen from the above analysis that China's agricultural trade partners are limited to several African countries.

The remaining paper is organized as follows. Section 2 outlines the methodology used, model specification and estimation, as well as data used in this research. Section 3 presents and discusses the results of data analysis. Section 4 concludes with contributions and policy recommendations of the study.

## 2. Methods

### 2.1. Gravity model

Gravity model is one of the most popular modes used in international agricultural trade analysis. It was firstly known in international trade since the work of Tinbergen (1962), claiming that the size of bilateral trade flows between any two countries can be approximated by a law called the gravity equation, which was originally from a specification of Newton's gravitation theory. In the 1960s, the Gravity model was often used in the field of applied economics (Tinbergen, 1962; Pöyhönen, 1963). Although, at that time, there were other models used in international trade, such as the Ricardian model<sup>1</sup> and the Heckscher-Ohlin (HO) model<sup>2</sup>. However, the Ricardian and HO models are not able to explain important foundations for international trade. For example, country size and distance between countries have little to do with the structure of trade flows in both Ricardian and HO model. Later, Anderson (1979) proposed a theoretical foundation for the gravity equation, which was then used by others (Bergstrand, 1985, 1989, 1990; Deardorff, 1998).

Since then, the Gravity model has become a complete theoretical model and appeared superior in relating bilateral trade to the mass of these two countries and the distance that separates them. The mass of the countries is normally measured as the economic sizes of the countries involved. The notion of distance does not only relate to the geographical distance such as transportation costs, but also to other factors affecting transaction costs. Therefore, the Gravity model of trade is adopted in this study based on its ability in explaining various factors contributing to Sino-African agricultural trade.

Initially, the gravity equation was thought of merely as a representation of an empirically stable relationship between the size of economies, their distance and the amount of their trade (Anderson and van Wincoop 2003). In other word, the trade flow between two countries is proportional to the economic mass, and inversely proportional to the cost of trade. This standard formulation of the model, which is consistent with standard models of international trade (Anderson, 1979, or Anderson and van Wincoop, 2003), is commonly extended to include other factors generally perceived to affect bilateral trade relationships.

The basic gravity model takes the form of  $V_{od} = \tau_{od}^{1-\sigma} Y_o E_d$ .

Where o is export country, d is import country; v is trade flow.  $\tau_{od}^{1-\sigma}$  is the trade cost increasing with distance, tariff, language and etc; Y is the supply from export country; E is the demand of import country. As to agricultural trade, Y and E generally represent the agricultural products

<sup>1</sup> Ricardian model relies on differences in technology across countries to explain trade patterns.

<sup>2</sup> Heckscher-ohlin (HO) model relies on differences in factor endowments among countries as the basis for trade.

output of export country and GDP of import country.

The major variables used in traditional gravity model include, demand variables (GDP), supply variables (outputs of agricultural products), and distance variables. However, as pointed out by Anderson (1979), trade between two regions was decreasing in their bilateral trade barrier relative to the barrier of the two regions to trade with all their partners, *ceteris paribus*. That is, the more resistant to trade with all others a region is, the more it is pushed to trade with a given bilateral partner. This theoretically appropriate average trade barrier is referred as multilateral resistance, and that will lead to biased estimation results if omitted variables reflecting multilateral resistance (Anderson, 1979). Nevertheless, in reality, the so called multilateral resistance is unobservable and difficult to measure directly. To reduce the bias caused by the lack of multilateral resistance, the fixed effect model is adopted, following the rules set by Anderson and van Wincoop (2003). Therefore, in this study, demand variables and supply variables are kept in the model, and the distance variables are omitted due to the use of fixed effect gravity model, as explained earlier.

In addition, other relevant variables are added into the model, including the variables affecting bilateral agricultural trade (such as import tariff, and China's investment in Africa), and dummy variable reflecting the impact of. Among these variables, import tariff and China's investment in Africa are the focus of this study. The gravity model has been transformed as follows.

The gravity model for China's import from Africa (import model):

$$\ln(im_{it}) = \ln(CGDP_t) + \ln(Aproduct_{it-1}) + \ln(Ctariff_{it}) + \ln(investment_{it}) + D_{criss} + \varepsilon_{it} \quad (1)$$

Where  $im_{it}$  is the current value of Chinese import from Africa;  $CGDP_t$  is China's current GDP, measuring Chinese demand;  $Aproduct_{it-1}$  is past output of agricultural products of African countries, measuring African supply. Using the past term is of help to get rid of autocorrelation and endogeneity (Chen et al., 2008).  $Ctariff_{it}$  is the current Chinese tariff to African agricultural products,  $investment_{it}$  is China's investment to Africa,  $D_{criss}$  is the dummy variable for global financial crisis (GFC), the values for 2008, 2009 and 2010 are assumed to be 1, others take 0.

The gravity model for China's export to Africa (export model):

$$\ln(ex_{it}) = \ln(AGDP_{it}) + \ln(Cproduct_{t-1}) + \ln(Atariff_{it}) + \ln(investment_{it}) + D_{criss} + \varepsilon_{it} \quad (2)$$

Where  $ex_{it}$  is current China's agricultural product export value;  $AGDP_{it}$  is current GDPs of African countries, measuring African demand;  $Cproduct_{t-1}$  is past output of Chinese agricultural products, measuring Chinese supply.  $Atariff_{it}$  is current African tariff for Chinese agricultural products,  $investment_{it}$  is China's investment to Africa,  $D_{criss}$  is the dummy variable for GFC, the values for 2009 and 2010 are assumed to be 1, others take 0.

Moreover, to deal with the zero value problems in trade dataset, truncated Ordinary Least Squares (OLS) approach is exploited in estimation. This approach is believed to perform well with models containing data with a cluster at zero, and is simple in sample selection (Manning et al., 1987). Therefore, truncated OLS estimation technique is applied to the fixed effect Gravity model in this study.

To test the reliability of the estimation results of fixed effect Gravity model using truncated OLS, alternatively, a Tobit model, including the samples with zero trade flow, is also used, following the approach suggested by Silva and Tenreyro (2006). The results using Tobit and truncated OLS are found to be very similar. Therefore, the results from truncated OLS are utilized for later discussion.

## 2.2. Data and variables

Data used in this study are from various sources (see details below), covering 1992-2010. It is worth noting that all price data have been converted into US dollars in nominal term, consequently, exchange rates are not included in the above two models. The classification of agricultural products used in this study follows that of World Trade Organization (WTO).

Data sources used in this study are as follows. The import and export data are from UN COMTRADE Database of United Nations Commodity Trade (UNCOMTRADE). GDP data are from World Development Index (WDI) of World Bank. Agricultural product output data are from Food and Agriculture Organization (FAO). Data on tariffs are mainly from the database of United Nations Conference on Trade and Development (UNCTAD), however, UNCTAD data are adjusted according to the announcement of Customs import & export tariff of the People's Republic of China (2005-2011), to reflect China's recent tariff reductions. Data on China's investments in Africa are from Statistical Bulletin of China's Outward Foreign Direct Investment. It is worth noting that the investment data before 2003 are not available, thus US\$ 700 million (investment in 2003) is taken as the default value applied to the years before 2003.

Table 2

Descriptive statistics on the variables used in the import and export models

| Variables              | Explanations of the variables                           | Observations     | Average | Variance | Min   | Max   |
|------------------------|---------------------------------------------------------|------------------|---------|----------|-------|-------|
| Import model           |                                                         |                  |         |          |       |       |
| $\ln(im_{it})$         | Values of China's import from Africa (US\$ 1,000)       | 278 <sup>a</sup> | 8.63    | 2.51     | -0.72 | 12.41 |
| $\ln(CGDP_t)$          | China's GDP (US\$ 1,000)                                | 278              | 21.26   | 0.71     | 19.90 | 22.50 |
| $\ln(Aproduct_{it-1})$ | Past (lag one) output of African countries (1,000 tons) | 278              | 6.38    | 1.41     | 3.38  | 9.33  |
| $\ln(Ctariff_{it})$    | China's tariff on African's agricultural products (%)   | 278              | 2.86    | 0.75     | 0.69  | 4.50  |
| $\ln(investment_{it})$ | China's investment in Africa (US\$ 1,000)               | 278              | 2.84    | 1.65     | -0.60 | 8.33  |
| Export model           |                                                         |                  |         |          |       |       |
| $\ln(ex_{it})$         | Values of China's export to Africa (US\$ 1,000)         | 355 <sup>b</sup> | 9.12    | 1.68     | 1.48  | 12.18 |
| $\ln(AGDP_{it})$       | GDP of African countries (US\$ 1,000)                   | 355              | 16.25   | 1.60     | 12.80 | 19.71 |
| $\ln(Cproduct_{t-1})$  | Past (lag one) output of China (1,000 tons)             | 355              | 13.47   | 0.13     | 13.28 | 13.72 |
| $\ln(Atariff_{it})$    | African's tariff on China's agricultural products (%)   | 355              | 2.91    | 0.50     | 0.25  | 4.28  |
| $\ln(investment_{it})$ | China's investment in Africa (US\$ 1,000)               | 355              | 2.24    | 2.11     | -3.22 | 8.33  |

Note: <sup>a</sup> there should be  $17 \times (19-1) = 306$  observations in import model, however, there are 28 samples' import data not available, such as Benin, Cameroon and Ethiopia. Therefore, there are 278 observations for this model.

<sup>b</sup> there should be  $20 \times (19-1) = 360$  observations in export model, however, the tariff levels of Libya from 2006 to 2010 are not available. Therefore, there are 355 observations for this model.

As mentioned earlier, there is a concentration pattern of agricultural trade between China and Africa, thus 17 African countries are used as China's importing countries and 20 African countries are used as China's exporting countries in the analysis (See Table 1). In 2010, these countries comprised 85% of China's agricultural import from Africa and 89% of China's agricultural export to Africa. In addition, as discussed previously, China's agricultural import is focused on a handful of products, thus eight categories of agricultural products are used in the analysis, namely, cotton, sesame, peanut, vegetables, fruits, cocoa, tobacco and fish. The eight categories made up about 80% of China's import from Africa during 1992 and 2010. Descriptive statistics on the variables used in the import and export models are listed in Table 2.

### 3. Results and discussion

#### 3.1. Analysis of factors affecting China's agricultural import from Africa

China's economic growth and increase in African agricultural product output level are two important forces driving China's agricultural import from Africa. The regression results (listed in Table 3) show that, if China's GDP increases 1%, *ceteris paribus*, its agricultural import from Africa will grow 0.59%. In the meanwhile, increases in African agricultural product supply have also played a positive role in African agricultural export to China. For instance, 1% of increase in African supply of the eight categories of agricultural products will cause 3.5% of upsurge in its agricultural export to China. Therefore, these two factors have propelled China's agricultural imports from Africa significantly.

Table 3  
Regression results for the gravity models of Sino-African agricultural trade

| Independent variables                                      | China's agricultural import from Africa | China's agricultural export to Africa |
|------------------------------------------------------------|-----------------------------------------|---------------------------------------|
| Ln (domestic GDP <sub><i>i</i></sub> )                     | 0.59**                                  | 0.42*                                 |
| Standard deviation                                         | (0.30)                                  | (0.26)                                |
| Ln(output of agricultural product <sub><i>it-1</i></sub> ) | 3.51***                                 | 2.99***                               |
| Standard deviation                                         | (0.68)                                  | (0.97)                                |
| Ln (import tariff <sub><i>it</i></sub> )                   | -0.88***                                | 0.06                                  |
| Standard deviation                                         | (0.27)                                  | (0.19)                                |
| Ln (China's investment to Africa <sub><i>it</i></sub> )    | 0.29**                                  | 0.20***                               |
| Standard deviation                                         | (0.13)                                  | (0.07)                                |
| Financial crisis 2008-2010                                 | -0.81*                                  | -0.07                                 |
| Standard deviation                                         | (0.43)                                  | (0.25)                                |
| N (observations)                                           | 278                                     | 355                                   |
| R <sup>2</sup>                                             | 0.44                                    | 0.37                                  |

Note: Standard errors are in parenthesis, \*\*\*, \*\* and \* indicate significance at 1%, 5% and 10%, respectively.

In addition, reduction in tariff and increase in investment are also found to push China's agricultural import from Africa substantially. As shown in Table 3, 1% of import tariff reduction

will cause 0.88% of increase in agricultural import from Africa. For the meantime, China's investment to Africa is also found to increase China's agricultural import from Africa notably. The regression results indicate that, 1% of increase in China's investment will lead to 0.29% of rise in China's agricultural import from Africa. After several rounds of tariff reduction, China's import tariff level applied to African agricultural products has been very low. Therefore, there is limited room to further increase China's agricultural import from Africa by reducing its import tariff. In contrast, it is promising to boost China's agricultural import from Africa effectively by increasing China's investment in Africa, given the fact that Chinese investment in Africa is currently still very low. The regression result reveals that 1% of investment growth in Africa will lead to 0.29% of increase in China's agricultural import. With the improvement of investment environment and economic development in Africa, it is expected that China's investment to African will play an increasingly important role in promoting China's agricultural import from Africa.

However, it is worth noting that the GFC has negatively affected China's agricultural import from Africa. For example, GFC in 2008 caused 55% of decrease in China's agricultural import from Africa. This can be explained by the fact that, in 2008, a large proportion of China's agricultural imports focused on cotton and sesame, which made up 36.6% and 28.2% of China's agricultural import from Africa. While the GFC in the second half of 2008 led to severe market downturns, China's textile industry was greatly suffered. As a derived demand, therefore, the demands for cotton and other textile materials decreased. The statistics show that China's average cotton import from Africa nearly halved during the GFC period, from 3 million tons during 2005-2007, to 1.8 million tons during 2008-2009. Accordingly, the value of cotton imported decreased from US\$ 570 to US\$ 310, respectively.

### *3.2. Analysis of factors affecting China's agricultural export to Africa*

The economic development in Africa and the growth of China's agricultural output has greatly boosted China's agricultural export to Africa. For example, if African GDPs grow 1%, *ceteris paribus*, China's agricultural export to Africa will increase 0.42% (See Table 3). As one of rapid economic development areas in the world, Africa, with an average annual economic growth rate of 6% since 2000, is expected to become a market with great potentials for China's agricultural products. The rapid economic growth in Africa will turn this region into a key market that any strategic business planner cannot overlook, and the rising demand for agricultural products will be the first opportunity turning up. In the meanwhile, the increase in China's agricultural output has also advanced its export to African countries. As the result shows, 1% of China's agricultural output growth will lead to 2.99% of increase in agricultural export to Africa during 1992-2010, with other things remained equal (See Table 3). Therefore, it is import to improve China's agricultural output and its competitiveness, so as to increase Chinese agricultural export to Africa.

In addition, China's investment to Africa is found to affect China's agricultural export to Africa in a positive way. For instance, the result indicates if China's investment to Africa increases 1%, *ceteris paribus*, its agricultural export to Africa will increase 0.2%. Therefore, China's investment to Africa is uncovered to increase both China's agricultural export to Africa and its agricultural import from Africa.

Different from the import, the GFC in 2008 didn't affect China's agricultural export to Africa much. China's agricultural export to Africa has been increasing continuously between 2008 and 2010, and the annual increase (compared with the previous year) in agricultural export to Africa was US\$ 270 million in 2008, US\$ 90 million in 2009 and US\$ 120 million in 2010. This can be explained by fast recovery of African economy from the GFC and foods as China's main agricultural exports to Africa. WDI database shows that Africa's average annual GDP growth rate was 6.0% during 2003-2008. Although the GFC made it drop to 3.1% in 2009, it backed to 5.0% quickly in 2010. Furthermore, China's agricultural exports are mainly inelastic goods, such as processed foods, vegetables and fruits. Therefore, the demand for the exported Chinese agricultural product didn't decrease much, even when African household income was negatively influenced by the GFC.

#### 4. Conclusions and policy recommendations

This study adopted the fixed effect Gravity model to analyze various influential factors contributing to Sino-African agricultural trade. The conclusions and policy recommendations from the study are as follows.

China's tariff reduction and investment policies are found to play positive roles in stabilizing and promoting Sino-African agricultural trade. China has implemented a series of measures to promote Sino-African cooperation and agricultural trade, such as reducing import tariff and increasing investment since FOCAC was successfully launched in 2000. As a result, according to our estimation, 1% of tariff reduction will lead to 0.88% increase in China's agricultural import from Africa; and 1% of investment growth will lead to 0.29% increase in China's agricultural import from Africa. Although the tariff reduction played significant roles in promoting China's agricultural import from Africa in the past, its future roles have been limited due to the current low tariff level applied to African imports. In contrast, investment to Africa is expected to play a chief role boosting China's agricultural import from Africa in the future.

In the meanwhile, China's investment to Africa has also played a positive role in boosting China's agricultural export to Africa. With other things remain equal, 1% of investment growth will lead to 0.20% of upsurge in African's import from China. Therefore, the focus should be put on the positive roles China's investment playing in the long run.

Rapid economic growth of China and African countries has provided a broad space for Sino-African agricultural trade. The economic growth is one of the key forces driving agricultural trade between China and Africa. For example, if China's GDP increases 1%, *ceteris paribus*, China's agricultural import from Africa will rise 0.59%. Also, if African countries' GDPs grow by 1%, *ceteris paribus*, China's agricultural exports to Africa will expand by 0.42%. It is reasonable to expect that Sino-African agricultural trade will expand further, if the economy of both sides grows continuously.

In addition, the increase in agricultural product output plays a momentous role in propelling Sino-African agricultural trade. Our estimation shows, 1% of African agricultural product output upsurge will lead to 3.50% of increase in China's agricultural import from Africa, and 1% of Chinese agricultural product output rise will lead to 2.99% upsurge in China's agricultural export

to Africa. Therefore, it is important to constantly increase Sino-African agricultural cooperation, fully use natural resources and technical comparative advantages of both sides, and further enhance the outputs of agricultural products in China and Africa.

### List of abbreviations used

|            |                                                    |
|------------|----------------------------------------------------|
| FAO        | Food and Agriculture Organization                  |
| FDI        | Foreign Direct Investment                          |
| FOCAC      | Forum on China-Africa Cooperation                  |
| LDC        | Least Developed Country                            |
| MDG        | Millennium Development Goal                        |
| OLS        | Ordinary Least Squares                             |
| UNCOMTRADE | United Nations Commodity Trade                     |
| UNCTAD     | United Nations Conference on Trade and Development |
| WDI        | World Development Index                            |
| WTO        | World Trade Organization                           |

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