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Multilateral Trading System and the Potential for Sino-African Trade

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Abstract

The emergence of China as world trade power opens another channel of trade relations in Africa. Prior to 1994, China operated an inward-looking, state controlled closed economy and only had to review her economic policies and thus gave priority to market forces since she became a member of WTO. This paper applies the extended gravity model to analyze the trend, intensity and potential of Sino-Africa trade and investigate the effect of multilateral trade system in influencing seeming changing pattern of African trade. Both Heckscher-Ohlin and the Linder hypotheses are tested. The model is tested on a sample of 30 African countries trading with China. A panel data analysis with time variant and time invariant variables are used to capture the relationships between relevant variables over time. The period of study is 1995-2007. Three methods of estimation were used: pooled OLS, Fixed Effect and H-T. The latter method was preferred and used. The paper shows that per capita income; per capita income differential, geographical distance and consumer price index are important determinants of bilateral export flows between China and the selected African countries. Our results support the Linder hypothesis. However, future research should envisage a more detailed study of the pattern of commodity trade between the two regions.

Introduction

The world trading system has been largely functioning under the General Agreement on Tariff and Trade (GATT) of 1949 now World Trade Organization (WTO). The basic tenet of WTO is to facilitate global trade and improve wellbeing of the citizens of the participating countries. Today, we are a washed in the annals of international trade with terms such as free trade, multilateralism,

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regional integration/preferential trading arrangements, North-South cooperation, South-South trading arrangements and more current, globalization. Many developed and developing countries have been operating under one or several of these forms of trade. However, it is generally agreed that free and fair multilateral trading system is more beneficial to developing economies that adopted economic and trade liberalization policies.

According to Kumar (2008), the Uruguay Round (1986-94) and the implementation phase of WTO agreements (1995-2004) brought about tremendous changes in the global economic system. Within the period, there was a greater recognition of the role of trade as an engine of economic growth. There is also the need for more support to openness from developing countries as compared to rich industrialized countries which have traditionally championed the cause of the multilateral trading system. Prior to this period, 1995-2004, China operated an inward-looking, state controlled and closed economy. It was a planned economy. However, following the collapse of the Union of Soviet Socialist Republic (USSR), many other centrally planned economies had to review their economic policies and gave primacy to market over planning. By 1994, China became a member of WTO. Since her adhesion to the WTO, Chinese economy has experienced a tremendous economic growth. In this respect, between 2006 and 2007, the Chinese economic growth rate stood at 10.65 percent.

Part of the explanation for the high growth rate may be explained by the Chinese engagement with multilateral trading arrangement which has helped her to sustain the trade liberalization process that was started in 1978. One important aspect of this multilateralism is that it enables China to engage in trade with both developed and other developing countries. Meanwhile, multilateral arrangement in Africa was evolving from free trade to bilateral, multilateral, regional and now south-south. In particular, the presence of China in world trading system has

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thrown a big challenge to the existing order with her economy displacing those of Japan, Germany, France and Britain to rank second to the USA. One of the major implications of this is that developing countries, particularly those in Africa, now see China as an equally qualified partner thereby increasing trading relations with China. In 1995, shortly after Chinese ascension to the World Trade Organization (WTO), export of China to Africa stood at about 1.3 percent of her total exports. This proportion grew to 2.6 percent in 2007. Similarly, imports of China from African countries was about 1 percent of her total import in 1995 and increased to 3.5 percent in 2007. This level of trade thus raises a series of questions: Will the current picture results into African dependency on China similar to the former colonial experiences? Can China and Africa benefit from "similar economies" syndrome being both part of the South-South trade configuration? Or in the extreme, can China become the center of gravity for launching a new growth order for the Less Developed Countries (LDCs)?

In addressing some of these issues, one needs to consider different avenues of trade facilitation in Africa. Many developing countries have been operating under one or several forms of trade arrangements. However, it is generally agreed that free and fair multilateral trading system is more beneficial to liberalizing developing economies. Consequently, it is pertinent to investigate the trend and intensity in Sino-African trade, the commodity component of the trade relationship, the potential for trade, and the possibility of a shift in the direction of trade from North-South to South-South with a view to assessing if South-South trade can engender economic growth.

Therefore, this paper examines the determinants of bilateral trade flows between China and its major partners in Africa as well as with main partners in the industrial economies. The paper develops an extended gravity model of international trade to empirically investigate the relationship between the volume and direction of international trade in a multilateral trading regime. Panel data

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obtained on a sample of 30 African countries is used This is subdivided into three regional trade areas: the Economic Community of West African States (ECOWAS), the Southern Africa Development Community (SADC) and Common Market for East and Southern Africa. With the panel data analysis the paper disentangles the time invariant country-specific effects and captures the relationships between the relevant variables over the period of estimation.

The remaining part of this paper is structured as follows: Section 2 presents a synopsis on the Chinese Trade Relations with the Rest of the World. Section 3, presents a brief review of related literature. Section 4 contains the research methodology including the derivation of extended gravity models of international trade, the econometric issues, empirical strategy and data sources and measurements. In Section 5, the paper evaluates the Estimations and Results including the Preliminary Data Analysis and Interpretations and discussion of the results. Section 6 concludes the paper.

Chinese Trade Relation with the Rest of the World

Sino-World Trade: A Synopsis

Since China became a member of the World Trade Organization (WTO) there has been an upsurge in its trade with the rest of the world. The process of moving China from inward-looking to an outward-looking economy started in 1978. The policies adopted from then open the Chinese economy to the dynamic benefits of international trade such as competition, efficiency and technology improvement effects. One key policy was the trade liberalization which reduced trade barriers and enhanced openness to the world. Over time, import tariff has been falling from an average of 10.4% in 2004 to 10% in 2008. She has engaged policies to eliminate import quotas, licenses and other tariff barriers. She is also committed to trade openness in trade in services. The implications of these policies can be seen in increased overseas market access.

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In this respect, Table 1 shows the export of China by major regional destinations. While Asia constitutes the major export market for the Chinese goods it will be seen that the proportion of total trade to this region has been falling over time: 40.1 % in 1995 and 32.2 in 2007. Multilateral trading regime has prompted search for market beyond the Asian region. However, the region

Table 1: Export of China by Major Destinations (1995-2007) in US$million

Region/Year	1995	%	1998	%	2001	%
Africa	1990.4	1.3	3381.4	1.8	5058.1	1.9
Asia	59673	40.1	63391	34.5	87691	32.9
Middle East	3437.2	2.3	4709.8	2.6	8028.2	3.0
Latin America	2986.2	2.0	5161.8	2.8	8022	3.0
United States	24744	16.6	38001	20.7	54395	20.4
Europe	3658	2.5	4887.6	2.7	7770	2.9
World	148959		183746		266709	

Source: Computed from IMF DOT (2008)

Table 1 continued: Export of China by Major Destinations (1995-2007) in US$million

Region/Year	2004	%	2006	%	2007	%
Africa	12083	2.0	22888	2.4	31898.6	2.6
Asia	198339	33.4	318356	32.8	391741	32.2
Middle East	18593	3.1	33280	3.4	49010.3	4.0
Latin America	17824	3.0	34527	3.6	49293.7	4.1
United States	125155	21.1	203898	21.0	237822	19.5
Europe	25322	4.3	56147	5.8	82049.4	6.7
World	593358		969284		1218170	

Source: Computed from IMF DOT (2008)

still remains the main partner thus indicating the importance of market proximity even without being member of a regional economic integration. The volume of trade is low with respect to other regions; Europe, Latin America, Middle East and Africa. The import of China follows a similar trend. Though Asia remains the major origin of imports, its portion in total imports has been falling, Table 2. With sharp variations in annual growth rate of exports and imports, Tables 3 shows that over the period of study average growth rate of total Chinese export to the world

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was 19.8 percent; 25.4 percent to Middle East, 27.7 percent to the Latin America and 31.6 percent for Europe. However, this statistic is only 18.1 percent for Asia. Similarly, the average growth rate of total imports from the regions selected was 18.8 to the world; 36.0 percent for the Middle East; 30.3 percent for Latin America and 17.6 percent to Europe. In the case of Asia, average growth rate of import was 19.7 percent. In both cases of import and export these figure are consequences of multilateralism. See Table 4.

Table 2: Import of China from Major Origin (1995-2007) in US$million

Region/Year	1995	%	1998	%	2001	%
Africa	1354	1.02	1425.35	1.02	4522	1.86
Asia	44573	33.73	52700.5	37.54	86190	35.39
Middle East	2190	1.66	3199.46	2.28	9307	3.82
Latin America	2751	2.08	2898.09	2.06	6586	2.70
United States	16123	12.20	16997.3	12.11	26221	10.77
Europe	5521	4.18	4508.15	3.21	10504	4.31
World	132164		140385		243567	

Source: Computed from IMF DOT (2008)

Table 2 continued: Import of China from Major Origin (1995-2007) in US$million

Region/Year	2004	%	2006	%	2007	%
Africa	15040.8	2.68	26856	3.39	34161.3	3.53
Asia	211212	37.62	3E+05	36.75	359022	37.11
Middle East	22243.5	3.96	42733	5.40	48671.4	5.03
Latin America	21516.4	3.83	33514	4.23	49251.6	5.09
United States	44772.6	7.97	59326	7.49	71230.4	7.36
Europe	18848.4	3.36	26580	3.36	33040.6	3.42
World	561422		791793		967346	

Source: Computed from IMF DOT (2008)

Sino-African Trade Relation: A Synopsis

Apart from increases in trade with geographical blocks, trade has substantially increased with African countries as a whole. From a level of about US$2 billion in 1995, total export to Africa has increased to almost US$32 billion

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in 2007. Similarly, export of African countries to China grew from about US$1.4 billion in 1995 to about US$34.2 billion in 2007. In this particular case of Sino-African trade, the total value of trade between China and Africa increased by 39.4 percent in 2007 with an average growth rate of 26.9 percent for the period under consideration. African exports to China increased by 27.2 percent between 2006 and 2007. Tables 1 to 2 give a summary of total value of exports and imports, in volume and proportion of total Chinese trade to Africa. Although the proportion of Chinese export to Africa has been on the increase over time, she is nonetheless the least Chinese trade partner. This is an indication of relative low significance of Sino-African trade relations, a situation that calls for reconsiderations.

Table 3: Annual/Average Chinese Exports by Destination (%)

Region/Year	1996	1997	1998	1999	2000	2001
Africa	4.4	27.1	28.1	-2.5	25.9	21.9
Asia	-5.3	28.3	-12.5	1.9	28.2	5.8
Middle East	1.4	19.5	13.2	13.3	31.6	14.3
Latin America	0.5	48.0	16.3	-3.4	38.5	16.1
United States	8.0	22.5	16.1	10.5	24.2	4.3
Europe	-1.6	28.2	5.9	-2.3	46.2	11.3
World	1.5	21.0	0.5	6.1	27.8	7.0

Source: Author's computations based on Table 1

Table 4: Annual/Average Growth Rate of Imports by Origin (%)

Region/Year	2002	2003	2004	2005	2006	2007	Average
Africa	20.1	50.4	84.2	32.7	34.5	27.2	38.5
Asia	30.0	39.7	34.9	18.8	16.0	23.4	19.7
Middle East	2.8	53.0	51.9	45.2	32.3	13.9	36.0
Latin America	24.7	79.6	45.9	22.0	27.7	47.0	30.3
United States	3.9	24.5	31.9	9.4	21.1	20.1	13.6
Europe	14.0	28.4	22.6	24.4	13.4	24.3	17.6
World	21.3	39.7	36.0	17.6	19.9	22.2	18.8

Source: Author's computations based on Table 2

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Table 5: Chinese Trade Structure by Major Products with Africa (US$ billion)

Year	Item	Agric	Food	R M	FMP	Fuel	NFM	Manu
1999	EX	0.41	0.4	0.01	0.09	0.06	0.01	3.53
	IM	0.45	0.09	0.36	1.3	0.97	0.06	0.31
	Tb	-0	0.31	-.35	-1.2	-.91	-.05	3.22
2000	EX	0.46	0.45	0.01	0.1	0.07	0.02	4.32
	IM	0.61	0.16	0.45	4.21	3.67	0.13	0.42
	TB	-0.2	0.29	-.44	-4.1	-3.6	-.11	3.9
2001	EX	0.42	0.41	0.01	0.16	0.11	0.03	5.14
	IM	0.62	0.16	0.46	3.36	2.69	0.13	0.49
	TB	-0.2	0.25	-.45	-3.2	-2.6	-0.1	4.65
2002	EX	0.06	0.04	0.02	0	0	0	1.1
	IM	0.18	0.02	0.16	1.55	1.33	0.18	0.39
	TB	-0.1	0.02	-.14	-1.6	-1.3	-.18	0.71
2003	EX	0.05	0.02	0.02	0.01	0.01	0	1.13
	IM	0.18	0.03	0.15	1.98	1.79	0.15	0.53
	TB	-0.1	-0	-.13	-2	-1.8	-.15	0.6
2004	EX	0.59	0.51	0.08	0.22	0.1	0.09	12.6
	IM	1.45	0.23	1.22	12.3	10.1	0.63	1.47
	TB	-0.9	0.28	-1.2	-12	-10	-.54	11.1
2005	EX	0.67	0.6	0.07	0.27	0.12	0.13	17.3
	IM	1.65	0.36	1.29	17.3	14.6	0.93	1.67
	TB	-1	0.24	-1.2	-17	-15	-0.8	15.6
2006	EX	0.88	0.82	0.06	0.43	0.13	0.28	24.5
	IM	1.97	0.41	1.56	24.5	21.1	1.09	1.87
	TB	-1.1	0.41	-1.5	-24	-21	-.81	22.6
2007	EX	1.16	1.05	0.11	0.68	0.17	0.49	34.4
	IM	1.93	0.38	1.55	31.2	26.1	1.45	2.61
	TB	-0.8	0.67	-1.4	-31	-26	-.96	31.8
2008	EX	1.57	1.42	0.14	1.19	0.5	0.65	47.8
	IM	1.99	0.48	1.51	49.5	39.6	2.41	2.89
	TB	-0.4	0.94	-1.4	-48	-39	-1.8	44.9
2009	EX	1.59	1.48	0.11	0.85	0.31	0.51	43.9
	IM	2.09	0.63	1.46	37.7	27.9	3.48	2.61
	TB	-0.5	0.85	-1.4	-37	-28	-2.9	41.3

Source: WTO, International Trade Statistics, 2002, 2004, 2006, 2008 and 2010.

Note: EX: Export; IM: Import; TB: Trade Balance; Agric: Agriculture; RM: Raw Materials; FMP: Fuel and Mineral Products; NFM: Non-Ferrous Metals; Manu: Manufacturing; I&S: Iron and Steel; Chem: Chemicals; MTE: Machinery and Transport Equipment; Text: Textile; and Cloth: Clothing.

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Table 5 cont.: Chinese Trade Structure by Major Products with Africa (US$ billion)

Year	I&S	Chem	OSM	MTE	Text	Cloth	Other	Total
1999	0.06	0.29	0.52	1.04	0.59	0.41	0.61	4.08
	0.02	0.12	0.11	0.05	0	0	0.06	2.38
	0.04	0.17	0.41	0.99	0.59	0.41	0.55	1.7
2000	0.05	0.31	0.62	1.21	0.05	0.56	0.72	4.9
	0.08	0.09	0.17	0.07	0	0	0.01	5.56
	-.03	0.22	0.45	1.14	0.05	0.56	0.71	-.66
2001	0.06	0.4	0.14	1.55	1.13	0.49	0.88	5.87
	0.1	0.13	0.15	0.11	0	0	0.01	4.79
	-.04	0.27	-0	1.44	1.13	0.49	0.87	1.08
2002	0.02	0.1	0.11	0.49	0.3	0.01	0.09	1.16
	0.25	0.05	0.01	0.07	0	0.01	0	2.13
	-.23	0.05	0.1	0.42	0.3	0	0.09	-.97
2003	0.02	0.11	0.14	0.62	0.32	0.01	0.1	1.37
	0.39	0.05	0.01	0.07	0	0.01	0.01	2.71
	-.37	0.06	0.13	0.55	0.32	0	0.09	-1.4
2004	0.37	0.76	1.41	4.23	2.48	1.53	1.82	13.6
	0.44	0.24	0.51	0.25	0.01	0	0.01	15.7
	-.07	0.52	0.9	3.98	2.47	1.53	1.81	-2.0
2005	0.42	1.09	2.19	6.42	3.02	1.81	2.29	18.5
	0.47	0.29	0.59	0.29	0.01	0.01	0.01	21.1
	-.05	0.8	1.6	6.13	3.01	1.8	2.28	-2.5
2006	0.9	1.46	2.99	9.46	3.93	2.72	2.99	26.2
	0.31	0.34	0.8	0.38	0.01	0.01	0.01	28.8
	0.59	1.12	2.19	9.08	3.92	2.71	2.98	-2.6
2007	1.67	2.06	4.22	13.6	4.76	4.19	3.92	36.5
	0.85	0.4	0.9	0.42	0.01	0.02	0.02	36.4
	0.82	1.66	3.32	13.2	4.75	4.17	3.9	0.17
2008	3.43	2.95	5.97	21.1	6.08	3.01	5.24	50.5
	0.9	0.54	0.96	0.4	0.01	0.04	0.03	56
	2.53	2.41	5.01	20.7	6.07	2.97	5.21	-5.4
2009	2.38	2.69	6.08	18.3	5.68	3.09	5.65	46.3
	1.04	0.55	0.66	0.26	0.01	0.06	0.03	43.3
	1.34	2.14	5.42	18	5.67	3.03	5.62	3.0

Source: WTO, International Trade Statistics, 2002, 2004, 2006, 2008 and 2010.

Note: EX: Export; IM: Import; TB: Trade Balance; Agric: Agriculture; RM: Raw Materials; FMP: Fuel and Mineral Products; NFM: Non-Ferrous Metals; Manu: Manufacturing; I&S: Iron and Steel; Chem: Chemicals; MTE: Machinery and Transport Equipment; Text: Textile; and Cloth: Clothing.

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Literature Review

The Logic of Gravity Model

The gravity model (GM) has become an important tool in the analysis and simulation of international trade flows. It is used in empirical works to evaluate the impact of regional agreements, the impact of monetary union, the impact of Foreign Direct Investment (FDI) on trade flows and to simulate trade potential. The methodology was adopted from Newton's law of gravitational force between two bodies. The law states that the gravitational force is directly proportional to the product of the masses of the bodies and indirectly to the square of the distance between them. The basic intuition for the adoption of the law is that bilateral trade flows between two countries depend directly on the product of the level of economic activities in the two countries and indirectly as the square of the distance between them. Earlier applications of the GM including Beckerman (1956), Tinbergen (1962), Polyhonen (1963), Linnemann (1966) and Aitken (1973) were basically atheoretical and were subject of intense critiques.

The general approach of trade analysts and in particular Linnemann is that trade flows between countries i and j is determined by three factors. First, is the supply of the exporting country i. This potential offer of the exporter is assumed to be a positive function of the income of the exporting country. This can be interpreted as a proxy for the available good varieties. Second, is the demand of the importing country, j. This is also postulated to have a positive relationship with the level of economic activity in the importing country. Third, is resistance to trade between country i and j. They agree that trade flows are influenced by national incomes of the participating countries, transport costs (transaction costs) and regional agreements.

According to Eichengreen and Irwin (1998), the gravity model of bilateral trade has become a workhorse of applied international economics. Its applications in empirical studies have produced plausible results which are sensible, intuitive

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and hard to avoid as a reduced theoretical model to explain trade (Deardorff, 1998). However, one of the controversies around GM was the absence of cogent economic theory. In this respect, several authors have provided theoretical explanations to the GM facilitated by the development of new international trade theory with imperfect competition and product differentiation (Anderson (1979), Bergstrand (1985), Helpman and Krugman (1985) and Anderson and Van Wincoop (2003). Deardorff (1998) has also shown that GM is consistent with the Hechsher-Ohlin trade theory under perfect competition.

One important development in the GM literature is the refinement due to Bergstrand (1989). According to Rault, Sova and Sova (2008:5), Bergstrand (1989) model provides an extension of Helpman and Krugman's model taking into account the supply and demand functions in explaining trade flows. This model includes income (GDP) per capita of the exporting and importing countries representing the capital intensities in each country and thus reflecting a relative factor endowment in terms of GDP per capita. In this formulation, GDP per capita is an indicator of demand sophistication in the sense that the goods may be either luxury or necessity good. The Bergstrand model appears to be the most complete version of GM since it included variables such as GDP, GDP per capita, distance and monetary variables (Rault et al., 2008).

The other major flaw of the GM is the absence of substitution between flows (Bikker, 2009). In effect, the existence of substitution can be made plausible by economic integration. In the presence of a Preferential Trade Agreement (PTA), increasing trade among members may be translated into decline in trade from non-member countries leading to gross trade creation. This will occur if the shift in the flow of goods is from higher cost to lower cost. Similarly, there may be the existence of gross trade diversion if member countries are constrained to seek supply from higher cost members in the presence of lower cost supplier non-members. It is important to note that the usefulness of the GM is in its application to analysis of economic integration for which trade creation and trade diversion are key phenomena. However, these are not described by the GM.

In addressing the problem adduced to in the preceding paragraph, Bikker (2009) proposes an extension of the GM with substitution between flows. The Extended Gravity Model (EGM) has strong similarities with the models of Bergstrand (1985), Anderson and Van Wincoop (2003) and Redding and Schott (2003). According to Bikker, the theoretical base of EGM is derived from the supply and demand equations which appear to be a generalization of the GM allowing empirical testing of the assumptions of the model. It is, however, noted that EGM estimation results may deviate widely from the estimation results of GM. The difference “underlines the importance of discerning the substitution structure”.

Research Methodology

The Derivation of an Extended Gravity Model

There are several alternatives to deriving a theoretically-based EGM. Anderson and vanWincoop (2003) derive an EGM from a CES preference function leading to an elegant micro-economic foundation for that model. Bergstrand (1985) type of EGM is derived from double constant-elasticity-of-substitution (CES) utility functions for consumers and double constant-elasticity-of-transformation (CET) joint production surfaces for producers. The author specifies supply and demand for each trade flow but links their aggregates over i and j to the respective countries’ national incomes.

Redding and Schott (2003) and Redding and Venables (2004) derive an EGM based on Cobb-Douglas preference and production functions. According to Bikker (2009), define (foreign) market access and (foreign) supply access in form that can be written identical to prices and price indices. The ‘new economic geography’ wage level in their model is a function of these access variables which in turn depend on prices. Bosker and Garretsen (2009) and Boulhol (2009) apply

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this approach. Finally, Behrens, Ertur and Koch (2007) develop an EGM that is a simplification of these other models as it contains only one set of indices, supply access, instead of two having ignored market access. This paper adopts the Bikker (2009) approach to modeling EGM. A brief discussion is as follows:

The paper begins with the supply and demand system that consists of four equations: supply, demand, allocation and index. The aggregate supply block, denoted as E_i^s, represents the total foreign supply of country i; C_i, its potential foreign supply and p_i the domestic price of export which is an index of a mix of export commodity prices. This relation can be written as follows:

$$E_i^s = \psi C_i p_i^{\nu}, \text{ for } i = 1, 2, ..., n, \text{ and } \nu > 0 \qquad 1$$

This means that potential foreign supply depends on the productive capacity for tradeable goods, which is proportional to the Gross Domestic Product (Y_i) if the ratio between productive capacity for tradeable and non-tradeable goods are equal in all countries. The micro-economic theoretic foundation of this equation can be found in Bergstrand (1985).

The second component is the demand block. This can be written as follows:

$$I_j^d = \gamma B_j q_j^{\phi} p_j^{\varphi}, \text{ for } j = 1, 2, ..., n, \ \ \phi > 0 \text{ and } \varphi < 0 \qquad 2$$

Equation 2 expresses total foreign demand of country j as a function of potential foreign demand, B_j; the price level of domestically produced tradeable goods and an index indicating the attractiveness of the whole commodity mix offered by all the exporting countries together. Bikker affirms that this index changes from country to country because of the distances between importing and exporting countries. It also depends on the foreign export prices.

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Equation 3 describes the geographical allocation of demand. In this block, supply and demand system consists of n markets, one for each exporting country. These markets are separated from one another by distances. On each market, m countries serve as demanders. The demand from each importing country is distributed over the n markets. The demand from country j for products of country i is denoted, $X_{i,j}^{d}$. Therefore, the share of country i in the total demand of country j, is given as $X_{i,j}^{d} / I_{j}^{d}$. The latter is a function of price, and on specific factors that either promote or hamper trade between country i and j. Among the constraining factors are distances (transportation and information costs), and preferential relations such as economic unions, ties with former colonies, amongst others.

This is put together symbolically in the following form:

$$\frac{X_{i,j}^{d}}{I_{j}^{d}} \propto p_{i}^{\mu} D_{i,j}^{\varepsilon} P_{i,j}^{\psi} \qquad 3$$

where $\propto$ symbolizes proportionality rule and such that $\mu < 0$, $\varepsilon < 0$ and $\psi > 0$. The restriction on equation 4.3 requires that $\sum_{i=1}^{n} X_{i,j}^{d} = I_{j}^{d}$. This condition is met if the proportionality is removed such that the equation becomes:

$$\frac{X_{i,j}^{d}}{I_{j}^{d}} = \frac{p_{i}^{\mu} D_{i,j}^{\varepsilon} P_{i,j}^{\psi}}{\sum_{k=1}^{n} p_{i}^{\mu} D_{i,j}^{\varepsilon} P_{i,j}^{\psi}}, i \neq j \qquad 4$$

Equation 4 describes the preference of country j to buy products from country i and has the form of the multinomial logit model widely applied to specify choice processes and is supported with theoretical foundation by means of a derivation from utility functions (Daganzo, 1979).

Finally, the attractiveness index equation. This is given as below:

$$q_{j} = \sum_{k=1}^{n} p_{i}^{\mu} D_{i,j}^{\varepsilon} P_{i,j}^{\psi} \qquad 5$$

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In equation 5, q_j denotes the extent to which producers satisfy consumers of j. It can also be regarded as a foreign price index, where the weights $D_{i,j}^{\varepsilon}$ and $P_{i,j}^{\psi}$ for $k = 1, 2, ..., n$ are proxies for trade costs and lower tariff rates for preferential trading arrangements, respectively (Bikker, 2009). The bilateral demand equation is obtained by substituting equations 2 and 5 into 5 to produce:

$$X_{i,j} = \gamma B_j q_i^{\rho-1} p_i^{\vartheta} D_{i,j}^{\varepsilon} P_{i,j}^{\psi} \qquad 6$$

The equilibrium prices are also given as:

$$p_i = \left[\gamma w^{-1} C_i^{-1} \sum\nolimits_{l=1}^{m} q_l^{\rho-1} p_l^{\vartheta} B_l D_{i,l}^{\varepsilon} P_{i,l}^{\psi} \right]^{1/\lambda - \mu} \qquad 7$$

For the purpose of empirical application of the equilibrium model, potential foreign supply is proxied by the Gross Domestic Product (Y_i) and the market size by population (N_i). This is based on "the assumption of economies of scale: the larger N_i is, the higher is the number of production lines for which the country will meet the minimum market size for efficient market production". This implies that the larger N_i is, the larger the domestic market will be in relation to the foreign market and therefore the smaller the potential foreign supply. This proposition is germane to this study in which the Chinese population is far larger than each of the countries being considered or even taken together. These assumptions coupled with some algebraic substitutions and manipulations on indices and parameters leads to the final EGM *a la* Bikker and are given as follows:

$$X_{i,j} = \gamma_0 \alpha_i^{\gamma_1 - 1} Y_i^{\gamma_2} N_i^{\gamma_3} \beta_j^{\delta_1 - 1} Y_j^{\delta_2} N_j^{\delta_3} D_{i,j}^{\varepsilon} P_{i,j}^{\psi} \qquad 8$$

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where $\alpha_i = \sum_{l=1}^{m} \beta_l^{-1} I_l D_{i,l}^{\varepsilon} P_{i,l}^{\psi}$ and $\beta_j = \sum_{k=1}^{m} \alpha_k^{-1} E_k D_{k,j}^{\varepsilon} P_{k,j}^{\psi}$ are identified set of indices that engenders empirically useful model and they are obtained from unidentified system of prices and indices. All the other variables are as defined elsewhere. In particular, if $\gamma_1 = \delta_1 = 1$, then equation 4.8 returns to the standard gravity model but now augmented with the inclusion of other explanatory variables. The coefficient α_i is similar to what Redding and Schott (2003) describe as a measure of 'market access' i. e. the sum of market capacities in the importers it serves weighted by the bilateral costs for each exporter, $i = 1, 2, ..., n$ Similarly, β_i is the sum of supply capacities in the exporters that it receives goods from, weighted by the bilateral costs for each importer $j = 1, 2, ..., n$. In this study, this factor can only be calculated in the case of China, in both directions. Therefore, the effects of market access and supply access of China in the African export and import markets are subsumed under other variables (Redding and Venables, 2001) such that equation 8 can be re-written explicitly as follows:

$$X_{i,j} = \theta Y_i^{\gamma_1} N_i^{\gamma_2} Y_j^{\delta_1} N_j^{\delta_2} TC_{i,j}^{\varepsilon} PT_{i,j}^{\psi} \qquad 9$$

Econometric Issues

It is obvious that the EGM presented in equation 9 is cross-sectional when individual country is taken into consideration. This has been the approach in regression estimations of gravity models. However, bilateral trade analysis based on cross-section data leads to biased estimates since they do not control for unobserved individual heterogeneity. Besides this problem, there is also the problem of misspecification. Matyas (1997) proposes a 'three-way' model with exporter, importer and time effects (random or fixed effects). Once the time dimension is plugged into equation 9, then the most appropriate approach is the panel gravity model. The advantages of using panel method include: (1) panels

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can capture the relevant relationships among variables over time, (2) panels can control for unobservable trading-partner-pairs' individual effects, and (3) panel data augment the degree of freedom because of increased sample size and thereby provide efficient estimates. This study therefore applies the panel method to equation 9.

It is known that the presence of unobserved individual heterogeneity is a source of potential bias to the estimation of gravity models (Rault et al., 2008). Therefore, in addressing this issue the paper examines the most appropriate econometric methods for comparison and robustness of the estimates. In effect, using Pooled Ordinary Least Squares (POLS) does not control for the individual heterogeneity present in the data and therefore can produce biased estimate. This may be due to the presence of correlation between some explanatory variables and some unobserved components. Thus, OLS applied on the gravity model is inappropriate if the Breuch-Pagan LM test rejects the null hypothesis in favor of random effect.

In view of the problem adduced to in the preceding paragraph, fixed effect (FE) or random effect (RE) models can be tested. The main difference between the two is the imposition of the assumption concerning the unobserved effects and the explanatory variables. It is such that: $\mathrm{Cov}(\mathrm{X}_{itk}, \lambda_i) = 0$, for $t = 1, 2, ..., T$ and $j = 1, 2, ..., k$, under the RE hypothesis. However, the latter hypothesis is less plausible and the GLS estimator may lead to biased results. The use of FE is also constrained by the fact that it may not estimate the time invariant variables that are eliminated by the data and fixed effects estimator ignores variations across individuals.

To obtain a more realistic set of estimates, the Hausman-Taylor (1981, hereafter H-T) is being proposed. The H-T approach is to eliminate the problem caused by the potential existence of correlation between the unobservable characteristics and a subset of the explanatory variables which could lead to

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biased estimates consequently misleading inference. The H-T proposes a better approach to handling the data set when regressors are correlated with individual effects. The estimation strategy in this case is based on Instrumental Variable (IV) method where instruments are derived from internal data transformations of the variables in the model Mitze (2010). To carry-out the test, one needs to rewrite the model in a special format as follows:

$$Y_{it} = \beta_0 + \beta_1 X_{1it} + \beta_2 X_{2it} + Y_1 Z_{1i} + Y_2 Z_{2i} + \lambda_i + \eta_{it} \qquad 10$$

where λ_i denotes unobserved individual effects, fixed over time and such that the explanatory variables are not correlated with η_{it}, even though some of them may be correlated with λ_i. Equation 10 contains four categories of explanatory variables: Time-variant uncorrelated (X_{1it}), time-variant correlated with λ_i (X_{2it}), time-invariant uncorrelated (Z_{1i}) and time-invariant correlated with λ_i (Z_{2i}). The (X_{2it}) regressors are instrumented by the deviation from individual means (as in Fixed Effect approach) and the (Z_{2i}) regressors are instrumented by individual average of (X_{1it}) regressors. The H-T method allows for the inclusion of time-invariant variables in the model (distance, common border, common languages, etc), permits us to circumvent the problem of an ad hoc estimation of the country-specific dummy variable, and removes the correlation between the error term and the included variables which often plagues RE estimations.

Empirical Strategy

The empirical model retained in this paper to characterize bilateral trade between China on the one hand and thirty African countries on the other is written as thelogarithm transformation of equation 9 and it is of the form:

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$$\log(BX_{ijt}) = \xi + \gamma_1 \log(YE_{it}) + \gamma_2 \log(PE_{it}) + \delta_1 \log(YI_{jt}) + \delta_2 \log(PI_{jt}) + \varepsilon_1 \log(DIS_{ijt})$$
$$+\eta \log(DKP_{ijt}) + \mu \log(CPE_{it}) + \omega \log(CPI_{jt}) + \varepsilon_2 \log(INF_{ijt})$$
$$+\psi_1 \log(EXR_{ijt}) + \sum_{k=2}^{3} \psi_k DUM_k) + v_{ijt} . \qquad 11$$

where the index indicates Chinese exports to country j for time period t and imports to China from country j, respectively. The variables in the model are defined as follows:

- BX : Bilateral export flow from China to country j,
- YE and PE: gross domestic product and population of the exporting country i, respectively
- YI and PI : gross domestic product and population of the importing country i, respectively
- DIS: Geographical distance between Beijing and national capitals
- DKP: $(YCE - YCI)^2$ i.e. square of the difference in income per capita to capture differentials in economic development between country i and country j
- CPE and CPI : Consumer price index in the exporting and importing countries, j
- INF : Measure of the level of infrastructure as a sum of telephone and internet per 1000 inhabitants
- EXR: Exchange rate in units of currency of the importing country, j, per a unit of US$
- DUM_2: ECOWAS membership dummy for country j
- DUM_3: SADC membership dummy for country j
- DUM_4: COMESA membership dummy for country j
- $\xi = \log \theta$
- $v_{ijt} \simeq IIN(0, \sigma^2)$
- All the Greek letters are parameters to be estimated.

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In this paper, trade costs is a vector $TC_{ijt}^{'} = (DIS_{ij}, DKP_{ijt}, INF_{ijt}, CPE_{it}, CPI_{jt})^{'}$, and preferential trade agreements is also a vector such as $PT_{ijt}^{'} = (EXR_{jt}, DUM_{jkt})^{'}$.

In view of the special place of China vis-à-vis the African countries considered in this paper, trade costs, TC, such as adjacency, common language, colonial link, common currency, island and landlocked are not explicitly included in the empirical model.

For each of the method of estimation being proposed, we estimate bilateral export model, bilateral import model and total pair-wise trade. In all cases, the coefficients of the logged variables are elasticities. For the bilateral export equation (LBX), we expect that: $\gamma_1 > 0$, $\delta_1 > 0$, $\varepsilon_2 > 0$, and $\omega > 0$. $\varepsilon_1 < 0$, $\mu < 0$ and $\psi_1 < 0$ while the sign of η cannot be determined a priori. In effect, $\psi_1 < 0$ implies that the more the value of Chinese currency depreciates with respect to the US$, the cheaper the Chinese exports with respect to her trading partners, provided the partners currencies are depreciating at a lower rate. This inevitably improves the competitiveness of the Chinese economy. That η is positive means that the Heckscher-Ohlin hypothesis holds i.e. higher differentials in capital labor ratio is translated into more trade from the exporter to the importer partner. If η is negative then Linder assumption holds i.e. the larger the difference in per capita income between two countries, the lesser the expected value of trade between them. Postulate that $\varepsilon_1 < 0$, is to hypothesize that the shorter distance among partners reduces resistance or the incidence of impediments to trade and should be associated to higher trade and vice versa. The coefficients of the population (γ_2 and δ_2) are also ambiguous. The sign of γ_2 depends on whether the country exports less when it is big (absorption effect) or whether a big country exports more than a small country (economies of scale) Gbetnkom (2006). Finally, the dummies capture the effects of economic integration of ECOWAS, SADC and

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COMESA on trade with China. If $\psi_k > 0$ signifies the existence of trade creation in China while there is an expected trade diversion if these coefficients are negative. The coefficients on the bilateral imports and total trade of China can be described in the same manner.

Data Sources and Measurements

The paper covers a sample of 31 countries: China and 30 African countries of which 8 are from the ECOWAS, 10 from SADC, 9 from COMESA and the remaining 9 from other African countries. The number of countries in each region and of course the number of individual countries in the paper is determined by data adequacy. In addition, SADC and COMESA are examples “Spaghetti bowl” where some countries are members of both regional body. The period of analysis is from 1995 to 2007 taking into account that China became member of WTO in 1994.

Trade data and in particular the once being used in this paper contains zero or negligible values in the matrix of imports or exports. However, the empirical model being used is in logarithm form. Therefore, any attempt to use those values as they are will result into undefined values. To overcome this difficulty, one can discard the zero values from the sample. The consequence of this is that important information contained in the zero data may be lost. Besides this approach, the zero values can be replaced with arbitrary small values such that it could not have a significant effect on the sample. This also may introduce a form of arbitrariness into the analysis. A third solution is to use an estimation technique such as the Tobit which explicitly recognizes and deals with the zero values in the sample. This paper combines the first and the second options.

The annual import and export data used in the paper are obtained from IMF’s Direction of International Trade 2007 and they are expressed in US$ million at 2000 constant prices. The real income, implicit price deflator, consumer price index, exchange rate and population are obtained from World Development

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Indicator (2008). The distance between Beijing, the capital city of China and the capital cities of the African countries are obtained from Mayer and Zignago (2006) while the proxy for infrastructure (number of telephone and internet per 1000 inhabitants were also obtained from World Development Indicator (2008).

Estimations and Results

Preliminary Data Analysis

Table 5 shows the descriptive statistics of the panel variables used in the paper. The table reports the mean, the standard deviation as well as the minimum and maximum values of the variables. The total number of observations is also provided and it is given as 390. All the figures are in logarithms of the variables. Tables 6 and 7 present pair-wise correlation between the regressors in the export and import equations. The tables also indicate the level of significance. It could be seen that there is no problem of multicollinearity. However, the inclusion of geographical variable (LDIS) shows perfect correlation between LCPE, LYCE and LCPI and it was noted for the estimation. In effect, the constant term was not included because of this problem.

Table 5: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
lyce	390	2.728562	.1108741	2.547088	2.91421
lyci	389	2.762573	.4408583	1.906468	3.812007
ldpk	389	.1980759	.2496578	2.32e-07	1.247409
lexr	390	2.039982	1.031882	.0011928	3.985731
lcpe	390	2.076883	.0518156	2.020857	2.201931
lcpi	390	2.307348	1.855392	1.522873	13.46432
linf	390	.1737506	.1754063	-.3098039	1.574031
lbx	390	.3543359	.3558254	4.95e-13	1.684938
lbm	390	1.383377	1.128855	-2	4.074696
lbt	390	1.737713	1.322812	-1.954247	5.514034

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Table 6: Correlation Matrix for Bilateral Export Equation

	lyce	lyci	ldpk	lcpe	lcpi	lexr	linf
lyce	1.0000						
lyci	0.0945	1.0000					
	0.0627						
ldpk	0.0337	0.5859	1.0000				
	0.5078	0.0000					
lcpe	0.8395	0.0862	0.0312	1.0000			
	0.0000	0.0895	0.5399				
lcpi	0.0467	-0.3115	0.3384	0.0477	1.0000		
	0.3577	0.0000	0.0000	0.3476			
lexr	0.1452	-0.2587	-0.0993	0.1048	-0.0386	1.0000	
	0.0041	0.0000	0.0503	0.0385	0.4469		
linf	-0.0441	-0.2712	-0.2911	-0.0768	-0.2210	0.0058	1.0000
	0.3855	0.0000	0.0000	0.1300	0.0000	0.9089	

Table 7: Correlation Matrix for Bilateral Import Equation

	lyce	lyci	ldpk	lrpe	lrpi	lexr	linf
lyce	1.0000						
lyci	0.0945	1.0000					
	0.0627						
ldpk	0.0337	0.5859	1.0000				
	0.5078	0.0000					
lrpe	-0.0079	0.0107	-0.4300	1.0000			
	0.8760	0.8329	0.0000				
lrpi	0.0237	-0.3255	0.3285	-0.7187	1.0000		
	0.6401	0.0000	0.0000	0.0000			
lexr	0.1452	-0.2587	-0.0993	-0.0401	-0.0452	1.0000	
	0.0041	0.0000	0.0503	0.4301	0.3729		
linf	-0.0441	-0.2712	-0.2911	0.5550	-0.1986	0.0058	1.0000
	0.3855	0.0000	0.0000	0.0000	0.0001	0.9089	

In the empirical analysis that follows, the paper slightly modifies equation 11 in a manner that the analysis will capture economic development between African economies and China following the seemingly intensive trade flows and to avoid problem of multicollinearity that has been observed in the literature

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between exporter/importer income and differences in per capita income (Martinez-Zarzoso and Nowak-Lehmann, 2003). Thus, income per capita is used instead of the levels of income in the model. All other variables remain as previously defined. Equation 12 below is the estimated model.

$$\log(BX_{ijt}) = \xi + \gamma_1 \log(YCE_{it}) + \gamma_2 \log(YCI_{jt}) + \varepsilon_1 \log(DIS_{ijt})$$
$$+\eta \log(DKP_{ijt}) + \mu \log(CPE_{it}) + \omega \log(CPI_{jt}) + \varepsilon_2 \log(INF_{ijt})$$
$$+\psi_1 \log(EXR_{ijt}) + \sum_{k=2}^{3} \psi_k DUM_k) + v_{ijt} \qquad 12$$

The gravity model for Sino-African bilateral trade was estimated for export, import and aggregate trade using different methodologies to test for robustness: pooled ordinary least squares (POLS); random effect method (REM) and Hausman-Taylor (H-T) method. FEM does not allow for estimating time invariant variables such as distance and language therefore are not relevant in this paper. In the case of REM, it allows time-invariant variables but produces inconsistent estimators since it neglects possible correlation between unobserved effects in errors and the explanatory variables. Therefore, using H-T that incorporates the advantages of REM as well as correcting a plausible correlation of the heterogenous effects in errors with the explanatory variables is more appropriate in this paper Kien (2009). Consequently, the paper concentrates on the results obtained from H-T method.

Considering the export model, table 8 reveals that estimated coefficient on the level of income per capita variable has the expected positive sign and is very significant at the level of 1 percent. At first glance, 1 percent increase in the exporter's income per head (LYCE) raises the volume of export on the average by 0.92 percent. The coefficient of importer's income per capita (LYCI) is statistically insignificant. This means that the income per capita of the importer countries does not explain the flow of goods to China. However, the coefficient of

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the difference in the income per capita (LDPK), a proxy for differences in factor endowment, is significant at the level of 10 percent and carries a negative sign. This implies that trade between China and Africa satisfies the Linder assumptions. If this coefficient is positive then it would have been concluded that Sino-Africa trade is based on comparative advantage in accordance with the H-O theory. According to Linder's trade model, bilateral trade will be greater when the per capita GDPs in the trading countries are more similar. This result corroborates similar results as in Martinez-Zarzoso and Nowak-Lehmann (2003).

The coefficient on geographical distance (LDIS) has a negative sign and is statistically significant at level of 1 percent. This shows that distance negatively affects export flows implying that export trade flow increases with shorter distance. The coefficient is also elastic (1.2308) showing that the closer the trade partner to China the higher the trade flows. This estimate corroborates our finding in tables 1 and 2, where it was inferred that trade between China and its immediate neighbors is higher than trade with other regions.

The paper also includes exchange rate (LEXR), the exporter's domestic consumer price index (LCPE) and the importer's consumer price index (LCPI) with a view to using these variables to capture price competitiveness. The estimate of the coefficient of exchange rate shows that it is insignificant and carries a positive sign. This implies that exchange rate is not a determining factor in the Sino-Africa export flows. This is not surprising as other factor influence exchange rate determination in both regions.

The exporter's consumer price index is positive and statistically significant at the level of 1 percent. It is also elastic at 1.4013. The implication is that a small change in LCYE brings about a more than proportionate change in export flow of China to Africa. Overall, higher domestic price has a positive effect on Chinese export to Africa. The coefficient of importer's consumer price index is negative and statistically significant at the level of 1 percent. This means

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Table 8: Results of POLS, REM and H-T for Bilateral Export Model

Dependent Variable: LBX

Variable	POLS	Random Effects	Hausman -Taylor
Lyce	1.0699*** (4.66)	0.9427*** (8.41)	0.9227*** (8.12)
Lyci	0.2751*** (3.88)	0.0170 (0.17)	-0.0369 (-0.33)
Ldpk	-0.39991*** (-3.96)	-0.1674** (-2.11)	-0.1420* (-1.76)
Ldis	-0.9572** (-2.56)	-1.0595 (-0.76)	-1.2308*** (-13.64)
Lexr	-0.1183*** (-7.70)	-0.0016 (-0.08)	0.0293 (1.25)
Lcpe	1.0874** (2.24)	1.3223*** (6.18)	1.4013*** (6.57)
Lcpi	0.0061 (0.045)	-0.0534*** (-2.29)	-0.1009*** (-3.36)
Linf	0.0071 (0.05)	0.0393 (0.58)	0.0100 (0.15)
Ecowas	0.2761*** (5.62)	0.1267 (0.78)	0.4763*** (3.23)
Sadc	0.0281 (0.74)	0.0950 (0.67)	0.7153** (2.46)
Comesa	0.0002 (0.00)	-0.0980 (-0.64)	0.1827* (1.76)
constant	-1.5012 (-0.94)	-0.6222 (-0.11)	-0.692485 (-0.11)
No.of Groups	30	30	30
No. Of Obs.	389	389	389
F-stat	28.25	-	-
Adjusted R-squared	0.4358	0.2676	-
Wald Chi2	-	-	-
Sigma(u)	-	0.288374	0.0
Sigma(e)	-	0.115000	0.1138733
rho	-	0.862789	0.0

Source: Author's estimation results using STATA 10
Note: Time dummies are not reported. All variables are expressed in natural logarithms.
Estimations use White's heteroscedasticity-consistent covariance matrix estimator. Figures in parentheses are t-statistics where "*", "**", "***" denote significance at 10%, 5%, and 1%, respectively.

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that higher price level in the importer's economies implies reducing import from china. This coefficient is inelastic indicating that a proportional change in price brings about a less than proportionate change in export flow to African economies. That implies that price increases potentially make African countries non-competitive for Chinese exports given the fact that the Chinese exports are essentially finished goods.

There are three integration dummy variables in our extended gravity model: ECOWAS, SADC and COMESA. All the dummies are assigned the value of one when the corresponding condition is satisfied and value of zero otherwise. Under the H-T method being used, the coefficients are statistically significant at the standard levels (1%, and 10%) and all of them are positive. A positive and significant coefficient would have indicated trade creation. A negative and significant coefficient would have suggested trade diversion. Further, the coefficient of infrastructure (LINF) is statistically non significant suggesting that infrastructure is not an important determinant of export trade flow to Africa.

In terms of country specific effects, most effects are statistically significant at least at the level of 10 percent (Appendix A). Benin, Cameroon, Congo, Equitoria Guinea, and Mauritania are non-significant effects. Our results show that Zambia has the lowest propensity to Chinese export while Morocco has the highest propensity for Chinese export.

In the bilateral import model, Table 9, the income per capita variable for the importer, China, is highly significant at the level of 1 percent, carries a positive sign and is elastic. This implies that a proportional change in income per capita in the importer country brings about a more than proportional change in import flow. Thus, an improvement in the development index in China will require additional inflow of import from Africa to meet Chinese demand particularly in African exports which are primarily raw material: agricultural, and oil. However, income per capita by exporter (Africa) and the difference in per

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capita (LDPK) are non significant and they both have positive signs. Other time variables including exchange rate (LEXR), infrastructure (LINF), and the relative price in the exporting country are not statistically significant except the relative price in the importing country (LRPE) which is significant but negative. The implication of the latter is that when relative prices increases in China, its imports from Africa reduces in a significant manner.

Considering the time-invariant variables in the model, it follows that geographical distance- a proxy for cost of transportation- is statistically significant, elastic and negative. This means that the shorter the distance from China the more it trade with its neighbors. This result, though consistent with the hypothesis, it may not so in all cases. In a study on trade between South Africa and European and African countries, Agu (2010) finds a positive and significant distance coefficient. This is explained by the historical context of South Africa whose trading partners are mainly in the North and little trading with neighboring African countries.

Among the preferential trade agreement dummies introduced into the model, only one of the integrating dummy variables, COMESA, has coefficient that is significant at the level of 1 percent, elastic and negative. All the other integrating dummy variables are insignificant but positive. These results indicate that COMESA as a group has a negative impact on trade with China while ECOWAS and SADC have positive effect on trade with China though the coefficients are not significant.

The results of country specific effects of export and import of China with Africa are shown in Appendix A and B. In the case of export model, six countries do not exhibit statistical significant at least at the level of five. Of the twenty countries that have significant effects, thirteen of them carry negative signs while the remaining seven have positive signs. Morocco and South Africa have highest propensity for Chinese export (Appendix A). In the case of import model,

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Table 9: Results of POLS, REM and H-T for Bilateral Import Model

Dependent Variable: LBM

Variable	POLS	Random Effects	Hausman -Taylor
Lyci	4.9022*** (11.86)	4.8008*** (14.31)	4.6453*** (12.36)
Lyce	0.6273** (2.72)	0.5180 (1.24)	0.7203 (1.27)
Ldpk	-0.4369 (-1.35)	3.4424 (0.92)	0.1448 (0.36)
Ldis	4.2389** (3.52)	3.4424 (0.92)	-2. 9243*** (-7.39)
Lexr	-0.1443** (-2.82)	-0.0346 (-0.40)	-0.0211 (-0.19)
Linf	-0.8679 (-1.46)	0.2605 (0.62)	0.3816 (0.90)
Lrpi	1.9107* (1.69)	-2.4092** (-2.40)	-3.0027** (-2.85)
Lrpe	0.0728 (1.36)	0.0135 (0.15)	0.1981 (1.25)
Ecowas	-0.6907*** (-4.36)	-0.6371 (-1.03)	-0.1430 (-0.20)
Sadc	-0.0156 (-0.12)	-0.1151 (-0.30)	-1.8164 (-1.29)
Comesa	-0.1069 (-0.52)	-0.4487 (-1.03)	-1.4096** (-2.69)
constant	-30.7726*** (6.31)	-25.8578 (-1.73)	-
No.of Groups	30	30	30
No. Of Obs.	389	389	389
F-stat	27.89	-	
Adjusted R-squared	0.4326	0.3735	
RMSE	0.2674	-	
Wald Chi2	-	406.56	
Sigma(u)	-	0.748783	0.0
Sigma(e)	-	0.552604	0.547189
rho	-	0.647397	0.0

Source: Author’s estimation results using STATA 10

Note: Time dummies are not reported. All variables are expressed in natural logarithms. Estimations use White’s heteroscedasticity-consistent covariance matrix estimator. Figures in parantheses are t-statistics where “*”, “**”, “***” denote significance at 10%, 5%, and 1%, respectively.

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only nine countries have significant effects out of which five are negative and four are positive. Our results show that Algeria has the lowest propensity for Chinese import while Zimbabwe has the highest propensity for Chinese import.

Summary and Conclusion

The main objective of this paper is to analyze the trend and intensity of Sino-Africa trade and investigate the effect of multilateral trade system in influencing changing patterns of trade in Africa. To achieve these objectives, the paper examined the determinants of bilateral trade flows between China and her trading partners in Africa. As a preliminary analysis, we examined exports and imports of China with the rest of the world and with Africa with a view to understanding the current position of Africa vis-à-vis Chinese total trade. We then engaged well known trade theories providing basis for an extended gravity model which was used to empirically investigate the relationship between the volume and direction of international trade and their determinants. The panel data methodology on a sample of 30 African countries for the period 1995-2007 is used. The choice of the countries is influenced by data availability. The panel data analysis permits us to disentangle the time-invariant country-specific effects and to capture the relationships between the relevant variables over the period of estimation. The methods of estimation used in the paper are the pooled OLS, Random Effects and the Hausman-Taylor method.

The deterministic variables considered are real GDP of the countries, populations, distance between China and the other countries, the exchange rate, consumer price indices, and some integrating dummy variables to capture membership of regional groupings in Africa. We estimated extended gravity model discussed in Section 4 of the paper for export, import and total trade using three different methods of estimation.

The results show that Sino-Africa export trade is positively determined by the income per capita of the Chinese economy, and its consumer price index while it is negatively determined by geographical distance, per capita income differential of the countries considered, consumer price index in the importing countries and the integrating dummy variables. All other variables in the model do not affect the determination of the Chinese export to the African countries considered in the paper. The import model is positively determined by income per capita while geographical distance, relative price between China and respective African economy, and an integrating dummy negatively affect Chinese import from Africa.

It follows from these results that the level of economic development in China determines direction of Chinese export and the origin of its import. This means that higher economic development in China portends greater market for African export. Geographical distance is found to be inversely related to both Chinese export and import. This implies that China will be better off if it trades more with her immediate neighbors. However, this may be contentious in the case of Chinese import from Africa which, in terms of composition, are essentially raw materials which do not have substitutes and are non-competitive. It could have been expected that the coefficient of geographical distance be rather positive for Chinese import from African countries. It is also find out that per capita income differentials both in export and import were found to support Linder's hypothesis over the H-O hypothesis. This result seems to be plausible since H-O hypothesis is based on unrealistic assumptions of zero transportation cost and perfect competition.

The paper also finds that the level of development in the African countries, measured by income per capita of the countries considered in the paper, does not affect either Chinese export to or import from Africa. This tends to suggest that African economy may likely emerge once again as peripheral economies to China thereby repeating the old and present order of African trade with the developed industrial economies. A shift in trade within the South-South framework will still be beneficial to China than to Africa. In terms of research, therefore, more works should be carried out to ascertain if the current shift in trade towards China was not actually exaggerated in which case there may be need for country-by-country and product-by-product analysis.

The policy implication of the results obtained from this paper includes the fact that China needs to further liberalize its economy in order to allow more non-raw material imports to its economy. Currently, the Chinese currency is overvalued thereby discouraging imports. It will be necessary for it to undergo currency adjustment in order to promote imports from other countries particularly Africa. African countries must engage in the production of value-addition goods and services in order to improve on the present basket of raw material export to China. The paper suggests that African economies could engage in transforming its raw materials into intermediate goods imbedded with international quality standards: there lies the potential for Sino-African trade.

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Appendix A: Country Specific Effects for Export Model

Sn	Country	Country Effect	t-Statistics	p-value
1	Algeria	0.4734	7.75	0.000
2	Angola	-0.4869	-1.79	0.075
3	Benin	-0.0115	-0.14	0.886
4	Cameroon	-0.022	-0.25	0.803
5	Congo, DRC	dropped		
6	Congo	-0.0012	-0.02	0.988
7	Eq. Guinea	-0.0714	-0.4	0.162
8	Gabon	dropped		
9	Ghana	dropped		
10	Guinea	-0.3895	-4.24	0.000
11	Chad	-0.7259	-9.93	0.000
12	Kenya	dropped		
13	Madagascar	-0.9744	-3.22	0.001
14	Mali	-0.5235	-7.08	0.000
15	Mauritania	-0.0179	-0.17	0.866
16	Mauritius	-0.789	-2.5	0.013
17	Morocco	0.4845	6.05	0.000
18	Mozambique	-0.7064	-2.49	0.013
19	Namibia	-0.6451	-2.41	0.016
20	Nigeria	0.3181	4.64	0.000
21	Rwanda	-0.4285	-7.39	0.000
22	Senegal	-0.3542	-3.97	0.000
23	South Africa	0.48	1.78	0.075
24	Sudan	0.3534	6.22	0.000
25	Tanzania	-0.674	-2.3	0.022
26	Togo	-0.1586	-2.13	0.034
27	Tunisia	0.1523	1.94	0.053
28	Uganda	0.346	-6.09	0.000
29	Zambia	-1.0249	-3.33	0.001
30	Zimbabwe	-0.8133	-2.2835	0.004

Source: Author's Computation

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Appendix B: Country Specific Effects for Import Model

	Country	Country Effect	t-Statistics	p-value
1	Algeria	-1.1907	-4.03	0.000
2	Angola	3.1896	2.41	0.016
3	Benin	-0.4823	-1.24	0.217
4	Cameroon	0.2241	0.52	0.600
5	Congo, DRC	dropped		
6	Congo	0.3548	0.99	0.324
7	Eq. Guinea	-0.1327	-0.53	0.593
8	Gabon	dropped		
9	Ghana	dropped		
10	Guinea	-0.5586	-1.26	0.208
11	Chad	-0.688	-1.91	0.058
12	Kenya	dropped		
13	Madagascar	2.097	1.41	0.159
14	Mali	-0.2175	-0.6	0.550
15	Mauritania	-0.8409	-1.62	0.106
16	Mauritius	0.5163	0.34	0.516
17	Morocco	-0.3837	-1	0.320
18	Mozambique	1.2945	0.93	0.354
19	Namibia	0.7175	0.55	0.581
20	Nigeria	0.5437	1.65	0.100
21	Rwanda	0.23349	0.84	0.399
22	Senegal	-1.0339	-2.41	0.016
23	South Africa	2.6226	2	0.046
24	Sudan	2.1877	6.83	0.000
25	Tanzania	1.2139	0.84	0.402
26	Togo	-0.8027	-2.21	0.028
27	Tunisia	-1.3783	-3.64	0.000
28	Uganda	-0.1989	-0.72	0.474
29	Zambia	3.0294	2.02	0.405
30	Zimbabwe	3.4892	2.56	0.011

Source: Author's Computation