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ADDIS ABABA UNIVERSITY
SCHOOL OF ECONOMICS

**CHINA AND INDIA'S COMMODITY DEMAND BOOM,
THE CHINESE FDI AND THE PRIMARY SECTOR
LOCKING EFFECTS FOR AFRICA**

By

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the Primary Sector Locking Effects for Africa.”**

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Acronyms

ADs Asian Drivers

AGOA African Growth and Opportunity Act

ASEAN Association of South East Asian Nations

ECA Economic Commission for Africa

FAO Food and Agriculture Organization

FDI Foreign Direct Investment

GDP Gross Domestic Product

GMM General Method of Moments

GNP Gross National Product

GTAP Global Trade Analysis Project

HO Hecksher Ohlin

HOV Hecksher Ohlin Vanek

HS Harmonized System

IMF International Monetary Fund

IV Instrumental Variable

MDGs Millennium Development Goals

MFA Multi-Fiber Agreement

NIEs Newly Industrializing Economies

OECD Organization for Economic Cooperation and Development

OLS Ordinary Least Squares

PIM Perpetual Inventory Method

RCA Revealed Comparative Advantage

RCAI Revealed Comparative Advantage Index

ROW Rest of the World
RSCA Revealed Symmetric Comparative Advantage
RSCAI Revealed Symmetric Comparative Advantage Index
SAP Structural Adjustment Programmes
SITC Standardized International Trade Classification
SSA Sub-Saharan Africa
TNCs Trans National Corporations
UNCTAD United Nations Conference on Trade and Development
UNDP United Nations Development Project
WB World Bank
WDI World Development Indicators
WTO World Trade Organization

Abstract

The implications of the recent ADs' growth surge for the industrial development of African countries have been the subject of recent attention. The literature, however, focused on the impact of ADs' growing competitiveness in labor intensive manufactured goods on the industrial development strategy of the continent. This study, motivated by this bias in literature, explores whether the recent ADs' commodity demand boom significantly stimulated African countries to re-deepen their specialization in the production and export of traditional commodities. The study employed a non-parametric test of 'Galtonian regression method' to test the re-deepening specialization patterns of African countries. Then, the multi-country version of the HOV model is used to uncover the specialization patterns with the ADs' commodity imports and the Chinese FDI flows are used to augment the model. The non-parametric test shows that African countries are characterized by re-deepening specialization patterns with the exception of few countries and few sectors. While China's commodity imports are significantly locking African countries in the production and export of traditional commodities, China's FDI and India's commodity imports are not important in such patterns. Furthermore, the result indicates that the intensity of the impacts of China's commodity demand boom on the export structure of Africa varies across commodity groups and the indirect impacts are more significant than the impacts of direct bilateral commodity imports from African countries. This calls for innovative policy responses to China and the need to balance between the temporary resource windfall gain and the future industrialization strategies of the continent.

Key words and phrases: *export, commodity demand boom, the Asian Drivers, export structure and system GMM*

CHAPTER ONE

1. Introduction

1.1 Background

It is obvious that international trade is of immense importance for every nation in general. In particular, the role of trade in poverty reduction and economic growth is enormous in developing countries. ECA (2005), for instance, noted that Africa will not be able to achieve the Millennium Development Goals (MDGs), nor set itself on a sustainable path to growth and poverty reduction, without increased trade. However, Africa's participation in international trade is not only very weak but also characterized by poor performance. Africa's relative performance in the global market has reached drastically low levels in the past thirty years. Its share in the world merchandise trade, measured in value terms, has declined steadily since 1980's from around 6 percent to around 2 percent in 2002 (WTO, 2004). Such a picture is due, not only, to the weak economic and institutional structures in the home country but also to the demand side factors. One of the most important stylized facts of African exporters is that they have been facing sharp decline in prices for most of their commodities (Morrissey and Mold, 2006). Moreover, African exporters, particularly those who rely on few primary commodities, are susceptible to export earnings instability.

Recently, however, African countries have seen export demand boom¹ and world commodity prices experienced their peak. Africa's exports to China increased from \$ 1.4 billion in 1995 to \$ 34.4 billion by 2007 which is more than 200 percent increase. Similar pattern was also observed for imports over the same period. Between 2000 and 2003 the UNCTAD All Commodities Price Index rose from 100 to 105, and by 2007 it had reached 207 (Farooki,

¹ Demand boom is a demand peak that is much higher than the previous peaks.

2009). Farooki (2009) also noted that, although different commodities experienced different price increases, at the end of 2008 the indices for all sectors were above their 2000 values. Such commodity demand boom and world commodity price surge was generated in two different regions, the OECD economies and the emerging giant economies of Asia such as China and India (Farooki, 2009).

Towards the close of twentieth century, the Asian bloc grew to a dominant role in global trade, but this time driven by the dynamism of two large new Asian economies, China and India (Kaplinsky, 2007). Such dynamism followed their economic growth spurt in the late 1970's and early 1990's in China and India respectively. Given their continuous and remarkable economic progress and their sheer size (accounting two-fifth of world population and one-fifth of global income), the ADs² exert a sizeable impact on global commodity markets, trade patterns, and the economic prospects of other developing countries (Alemayehu, 2006, FAO, 2007 and Farooki, 2009). In particular, the ADs' growth surge is commodity intensive in the sense that those sectors that experienced above average growth such as infrastructure, construction and manufacturing are commodity intensive in nature (Farooki, 2009). Moreover, they experienced structural change with the share of foreign trade in GDP escalating since the 1990s. China's export as percentage of GDP, for instance, increased from 19 percent in 1990 to 40 percent in 2006 which is more than double. These, therefore, along with the ADs' 'large country effects', make the impact of ADs on the world commodity market and hence world commodity price non trivial (Kaplinsky *et al*, 2009). Streifel (2008) argued that, although the failure of supplies to keep pace, low stocks and depreciation of dollar have also contributed to the price surge, China (and India for some commodities) has been the major player in the recent commodity price surge for all commodities except petroleum. Kaplinsky *et al* (2009) also argued that China accounts for

² *Asian Drivers (ADs) in this study refers to China and India*

about 60 percent to 100 percent increase in global demand for most metals during the period 2000-2007.

Such progress of the ADs and their influence on world commodity markets has both opportunities and threats for African countries. Rising commodity demand from these countries may increase Africa's potential for primary commodity exports both directly, through expanding exports from Africa to China and India, and indirectly, because the price effect from rising Asian demand will increase Africa's earnings from primary commodity exports even if Africa's exporters do not sell to these Asian countries (Mayer *et al*, 2005 and Villoria, 2009). Kaplinsky *et al* (2006), moreover, noted that cheap consumer goods imports sourcing from the drivers (particularly, due to growing Chinese competitiveness) may enhance the welfare of African consumers. African producers also source cheap and appropriate intermediate and capital goods from these Asian countries. The Sub Saharan Africa import of cheap fabrics from China and India is important case in point (Kaplinsky and Morris, 2006). Hence, in this front, the expansion of the ADs may be complimentary to possible growth of African economies.

Nonetheless, these commodity demand surge and cheap imports from the ADs have important implications for the structure of African exports in the long-run. In particular, the possible danger of ADs' increased commodity imports (and its complementarity) is its implication for the industrialization of Africa if it locks African countries in the production and export of primary commodities in the long-run (Alemayehu, 2006). In other words, the increased commodity demand from the ADs may drive African countries to re-deepen their specialization in the resource sector instead of moving up the technological intensity in production and export. Furthermore, ADs' growing competitiveness in labor intensive manufactured goods pose severe threat on African manufacturing sector both in the home and export market (third market). On the domestic front, the ADs' cheap manufactured exports

displaced domestic producers in several African countries. The domestically produced clothing and furniture manufactures both in Ghana and South Africa and small scale foot wear industries in Ethiopia are important cases in point (Kaplinsky and Morris, 2006 and Tegegne, 2007). Such pattern, at its best, may intensify the de-industrialization process initiated by the liberalization policies embedded in SAP (Ajakaiye, 2006). Similarly, the ADs competitiveness (due to increased labor productivity and marketing efficiency) in manufactured goods has been displacing the African labor intensive manufactured goods in the third market. With MFA quota removal on Chinese imports, the AGOA exports to US collapsed by 17 percent and unit price index squeezed by half (Kaplinsky and Morris, 2006). Alemayehu and Atnafu (2008) also showed that China has been displacing African manufactured export from the third market.

In general, the growth of China and India offer developing countries both adjustment challenge (in some cases quite severe) and opportunities for growth. Whether the development opportunities are exploited or wasted will, however, depend critically on the policy responses and quality of institutions of each country (Coxhead and Jayasuriya, 2008)

1.2 Statement of the Problem

Given the sizable impact of ADs on the global economy, there has been a surge of interest on the implications of the ADs' growing trade engagement on the export structure of other developing countries. A bulk of studies analyzed the impact of the ADs on the export structure of Africa (see for example, Jenkins and Edwards (2005), Goldstein *et al* (2006), Stevens and Kennan (2006), Broadman (2007), Zafar (2007), Alemayehu and Atnafu (2008), Kaplinsky *et al* (2008), Kaplinsky (2008) and Jenkins (2008) among others). Several studies also analyzed ADs' impact on other Asian countries (see for example Ianchovichina and Walmsley (2001), Ahearne *et al* (2003), Eichengreen *et al* (2004), Greenaway *et al* (2006)) through the trade channel. Some studies also empirically analyzed the ADs' impact on Latin

American Countries (LACs) (for extensive surveys see Ledereman *et al*, 2008). In fact, less emphasis was put on the impact of India on other economies.

Nonetheless, the literature on the ADs' engagement in Africa focus on the impacts of ADs' growing competitiveness in (labor intensive) manufactured export on the African manufacturing sector (see for example Alemayehu and Atnafu (2008), Kaplinsky *et al* (2008) and Kaplinsky (2008)). Given the volume of ADs' primary commodity imports likely to keep growing over the coming two or three decades (Mayer *et al*, 2005), equally important issue, however, is the potential effects of the drivers' commodity demand surge on the structure of African export in the long run. Specifically, the ADs' growing commodity demand and the associated world commodity price surge may stimulate African countries to re-deepen their specialization in the production and export of the commodities demanded by these Asian giants. This argument is subject to three facts. First, further increases in commodity prices may impede continued movement up the scale of capital intensity in production with the corresponding changes in the patterns of trade (Krueger, 1977 cited in Coxhead and Jayasuriya, 2008). Second, as argued by Coxhead and Jayasuriya (2008), resource boom increases inter-sectoral competition for labor and the resulting rise in w/r ratio would threaten to limit expansion in manufacturing. Finally, processing of primary commodities would have large opportunity cost with ADs' demand in its place. Consequently, resource boom that generates positive income effects (at least directly measured) may have adverse long term developmental consequences.

On the other hand, FDI flows from ADs (specifically China) are also designed primarily to secure commodities and mineral resource assets (Ajakaiye, 2006 and Alemayehu, 2006). Put it differently, the Chinese FDI in Africa are qualitatively different in kind from the European and North American sourced FDI in the sense that it is driven primarily by the need to secure key commodity and energy assets as well as capturing untapped markets (Alemayehu, 2006).

Goldstein *et al*, (2006) also showed that 50-80 percent of Chinese FDI in Africa is in resource exploration and natural resource rich countries. In general, the argument, therefore, is that the Chinese FDI in Africa supports the traditional export specialization of the continent.

In sum, the ADs' commodity demand surge and the Chinese FDI flows may lock African countries in the traditional commodities sector and result in diminished manufacturing export opportunities. However, this may risk them vulnerable to trade-based shocks. This might also be deleterious if the growth of manufacturing in general, and of specific sectors within manufacturing, is argued to generate dynamic productivity gains through a variety of mechanisms. Hence, it is important to think and act on the possible impact of the ADs' trade and FDI flows in locking African countries in the production and export of primary commodities (Alemayehu, 2006). In this regard, therefore, it is imperative to know the possible impacts of ADs' commodity demand surge and FDI flows on the export structure of Africa in the long run. Thus, this study is aimed at investigating the indirect effects of ADs' commodity demand surge in locking African countries in the production and export of primary commodities in the perpetual manner.

1.3 Objectives of the Study

Given the above facts, the general objective of the study is to see whether the ADs' trade and the Chinese FDI relations with Africa have important impact on the structure of African exports in the medium to long run. Specifically the study is aimed to:

- i.* investigate whether African export structure is characterized by stickiness or changing patterns
- ii.* examine if the ADs' commodity demand surge is re-deepening the African countries' specialization in the production and export of primary commodities
- iii.* study the impact of China's FDI flows in Africa in locking African countries in the production and export of traditional primary commodities.

1.4 Hypothesis of the Study

Following their economic growth spurt in 1980s and 1990s, ADs expanded their trade and FDI relations with Africa, often bundled with their aid. Their impact on global economy in general and on Africa in particular is likely to be non trivial. Given the ADs' multifaceted engagement in Africa and their strategic move to secure access to raw material sources, one can hypothesize the following solutions to the above issues:

- i.* With the current encouraging world commodity markets, African exporters would shift resources towards the commodity sector and hence, re-deepen their traditional specialization.
- ii.* The current ADs' commodity demand boom and the associated commodity price surge would significantly be locking African countries in the production and export of primary commodities.
- iii.* Contrary to the FDI flows from the traditional sources, the resource and market seeking Chinese direct investment would negatively affect the movement towards production and export of labor intensive manufactured goods.

1.5 Methodology of the Study

1.5.1 The model

In empirical literature, to test whether export structure of a given country is stable or not a non-parametric test of simple correlation coefficient between the first and the second year Revealed Comparative Advantage (RCA) index is employed (Hoekman and Djankov, 1997). However, this technique has the disadvantage of hiding the dynamics of export structure for each commodity group. To test the hypothesis of re-deepening specialization the study uses a non-parametric test of Galtonian regression method along two approaches: the country-wise approach and the sector-wise approach. While the first tests whether countries are stable

across sectors and whether they tend to become more or less specialized intra-country, the latter, tests whether specialization patterns tend to converge across countries, within the same sector (Dalum *et al*, 1998 and Laursen, 2000).

In analyzing the impact of ADs' commodity demand boom on the export structure of Africa, the study employs the multi-country version of the HOV model. In trade literature the HOV model, which is a generalization of the celebrated HO theory, is used to test the factor content of net trade of a given country with the rest of the world (see Trefler, 1995 and Debaere, 1998). Hence, the HOV model is a preferred way of testing the HO model. In the model, trade patterns are determined by the differences in factor abundances and the differences in the factor intensities of goods, as predicted by the HO model. However, in the neoclassical framework trade patterns are determined by excess factor endowments. Hence, export performance in specific commodity (commodity group) is explained by the factor abundances of a country exporting that particular commodity. The model is augmented by the ADs' commodity imports and the Chinese FDI flows in addition to the standard HO model arguments (the endowment variables). To check for the self reinforcing effects in export specialization, the lagged dependent variable is included as an additional regressor and hence, requiring dynamic panel data model estimation.

The model would be estimated for samples of sub-Saharan African countries for the period of 1995-2007. Five commodity groups are identified based on two-digit Standardized International Trade Classification Revision Four (SITC Rev. four). This disaggregation has two explicit advantages. First, RCA is a commodity specific concept. Therefore, RCA is only practical at certain level of disaggregation. Second, the impact of ADs' commodity demand surge on the export structure of Africa, which is the subject this study, varies across different commodity groups. Hence, the model is estimated for each of the five commodity groups.

1.5.2 The data sources

The study covers the period between 1995 and 2007. Data on several variables before 1995 is either not available or characterized by extensive missing values. Further, the recent WB and IMF CD-ROMS (2007/08) provide data on several variables only until 2007. Sample countries for each commodity group are different. Nonetheless, most of the countries in the sample are common to these groups. The sampling procedure is that the top trading partners of China and India are selected, given the data availability. The study uses data collected from several sources such as the World Bank African Development Indicators (WB ADI) and the International Monetary Fund Direction of Trade Statistics (IMF DOTS). The study also uses the UNCTAD Handbook of Statistics (2008) online database and UNCTAD's World Investment Statistics (WIS) online database, the FDI STAT.

1.6 Significance of the Study

As it is obvious natural resources create a concentrated export structure which exacerbates economic volatility and thus reduces growth. Furthermore, specialization in the export of primary commodities is at an odd with economic diversification which in turn acts to the detriments of economic development. Consequently, in the medium to long run the role of traditional primary exports should be to facilitate export diversification. In this regard this study which analyzes the impact of ADs' trade and FDI relations on the export structure of African countries in locking them in the production and export of primary commodity sectors in the medium to long run would be of immense importance. The study is expected to provide African policy makers and governments with policy options in dealing with the ADs. The study also gives insights to how African countries minimize the risks and maximize the benefits of the ADs' engagements in Africa. Furthermore, the study draws the attention of researchers that would have focused on the ADs' impact on the export structure of Africa through their cheap labor intensive manufactured exports to this neglected area.

1.7 Scope and Limitations of the Study

The study is aimed to analyze the impact of ADs' trade and the Chinese FDI relations on the export structure of African countries. Specifically, the study is intended to explore the effect of ADs' commodity demand surge and Chinese FDI flows in locking African countries in the production and export of primary commodities in the medium to long run. The study doesn't explicitly take in to account the impact of ADs on the export structure of Africa through world commodity price. Rather, this would be approached indirectly by emphasizing the ADs' commodity import from the world commodity market rather than commodity imports from African countries. Furthermore, the study uses two-digit SITC revision four data which is relatively too aggregated and hence, hiding specific commodity level information. The study also doesn't emphasize the ADs' impact on the export structure of Africa through their cheap manufactured exports competition in the domestic and third market. This is rather the area emphasized by the literature elsewhere.

1.8 Organization of the Study

The rest of the study is organized as follows. In chapter two reviews of the theoretical and empirical literature are made. In the theoretical section a full account of theoretical issues pertaining to measuring specialization patterns and its dynamics are made. In the empirical section, the literatures dealing with ADs' effect on African export structure on several fronts are reviewed. The methodology of the study is dealt with in chapter three where theoretical framework and the model specifications are taken care. In chapter four, the estimation techniques of the study are shown and the estimation results are presented. Discussions of the results are also made. Finally, in chapter five, conclusion and policy implication of the study would be presented.

CHAPTER TWO

2. The Literature Review

In the previous chapter it is argued that the fast economic growth of ADs and its accompanied commodity demand surge, despite its short run benefits as a source of revenue, could have long run impact on the export structure of African countries. In this regard theoretical issues relating to specialization patterns and their dynamics are crucial. In the theoretical section, therefore, we briefly review how to measure the export specialization of countries. It is also devoted to measuring the dynamics of export specialization patterns. The last sub topic in the theoretical literature presents some stylized facts on the structure of African exports and the challenges to industrialization in Africa in general and the threats of ADs in particular. The empirical literature gives insights in to the empirical analysis on the impacts of the ADs on the pattern of export specialization in Africa through the trade and FDI channel.

2.1 The Theoretical Literature

2.1.1 Measuring Countries' Trade Specialization

Although the emergence of trade theories of Posner (1961), Kenen (1965), Vernon (1966) and Johnson (1968) attributed the classical (and the neoclassical) comparative advantage and the economies of scale equal importance as an explanation for why countries trade, as far as trade flows prediction between similar and different countries is concerned, comparative advantage is still the main theoretical explanation (Davies, 1997 in Benedicits *et al*, 2001). The determinants (sources) of comparative advantage, however, differed among trade theories. The Ricardian theory, for example, explained comparative advantage from costs and technological differences, but the HO theory considered factor price differences (Bander, 2002). In other words, Ricardian theory emphasizes international differences in the production

functions and abstracts from international differences in relative factor costs while the HO theory makes precisely the opposite assumption (Katrak, 1969). To put the idea more clearly, while the Ricardian theory is largely derived from the propositions on opportunity cost and labor specializations, the HO theory emphasizes the international difference in resource (factor) endowments as the source of comparative advantage. In fact, Alemayehu (2010) wouldn't see any difference between the two explanations as the difference in factor endowments give rise to the difference in factor costs. On the other hand, the Technological Gap and the Product Cycle Theories attribute technological innovation and technological change as a source of comparative advantage differences (Bander, 2002). Such different theoretical backgrounds make the measurement of comparative advantage and the empirical test of the theories laborious tasks.

The sign of the difference between the autarkic³ and free trade relative prices help to identify the good or industry in which a country has a comparative advantage: if the sign is positive the country has comparative advantage in the production and export of that particular good and if the sign is negative the country has comparative disadvantage (Deardoff, 1980). Hence, the measure of comparative advantage reflects the regional or cross country differences in hypothetical pre-trade environment-autarky. However, problem arises from the fact that there is no data relating to that environment. Since in reality all countries engage in some level of international trade, the true autarkic price and hence true or shadow comparative advantage is unobservable (Leishman *et al*, 1999). Katrak (1969) also noted that once countries begin to trade the difference in relative prices are reduced although they are not eliminated completely due to impediments to trade such as tariff, transportation cost and imperfect knowledge on part of traders. In general, comparative advantage faces a measurement problem as trade statistics reflect only post trade situations.

³ *Autarky is the condition where equilibrium prices are unaffected by factors external to the economy (Houk,1986)*

The path breaking work on the measurement of comparative advantage was done by Balassa (1965). Balassa (1965) introduced the concept of Revealed Comparative Advantage (RCA) as a way to approximate comparative advantage⁴. The concept of the RCA is that it shows the relative trade performance of individual country for a particular commodity. Balassa (1965) argued that since commodity trade pattern reflects inter country differences in relative costs and non-price factors, commodity trade patterns should reveal the comparative advantage of trading nations. He further maintained that as opportunity costs differ among countries and countries specialize in production and trade, the nature of specialization would be such that export structure of each country will be dominated by the product in which its comparative advantage will be stronger (Balassa, 1965). In sum, if trade performance is determined by comparative advantage, then direct observation of trade performance should reveal comparative advantage (Leishman *et al*, 1999). Hence, revealed comparative advantage has become one of the most popular measures of a country's comparative advantage in a specific commodity or commodity group compared to the world or selected region (Kilduff *et al*, 2005)

2.1.1.1 The Balassa Index of Revealed Comparative Advantage (RCA)

The various measures of global RCA⁵ that have been proposed to infer the existence of comparative advantage from actual (post-trade) data can be classified according to the variables involved in the measures: the exports, imports and net trade. The most widely used RCA measure built on exports as the only variable is the Balassa (1965) index (Benedicts *et al*, 2001). Balassa (1965) pointed out that a country's relative export share of a commodity in a

⁴ In fact, before Balassa (1965) introduced his famous RCA index, Hoover (1936) and Liesner (1958) had already contributed to the literature of RCA (Benedicts *et al*, 2001 and Utkulu *et al*, 2004). Liesner (1958) for instance proposed a simple measure of RCA

$$RCA = x_{ij} / x_{nj}$$

where X represents exports, i is a country, j is a commodity (or industry), and n is a set of countries.

⁵ The consistency of the RCA indices with most familiar theories of trade patterns has not always been clear, despite Balassa's effort. Like gravity model and the Grubel-Lyold indexes, RCA indexes are employed but 'do not get respect' (Richardson *et al*, 1999).

particular region reveals the comparative advantage in that commodity. The measure of international competitiveness, defined by Balassa (1965), the RCA index hence, compares the export share of a given commodity or sector in a country with the export share of that commodity or sector in the world market (Kilduff *et al*, 2005).

$$RCA_{ij} = \frac{x_{ij} / \sum_i x_{ij}}{\sum_j x_{ij} / \sum_i \sum_j x_{ij}} \quad (2.1)^6$$

x_{ij} shows the export of sector (commodity) i from country j

While the numerator of the index shows the percentage share of a given sector in national exports, the denominator shows the percentage share of a given sector in a defined region's (world) export. Alternatively, it can be interpreted as the country's share of sectoral export, $x_{ij} / \sum_j x_{ij}$ normalized by a weighted sum of export shares in all sectors, $\sum_i x_{ij} / \sum_i \sum_j x_{ij}$. The numerator varies from 0 (the sectoral exports are nil) to 1 (international monopoly) and the denominator also ranges from 0 to 1. Hence, the Balassa's Revealed Comparative Advantage (RCA) index ranges between 0 and $\sum_i \sum_j x_{ij} / \sum_i x_{ij}$ and is equal to 1 when $x_{ij} / \sum_j x_{ij}$ equals $\sum_i x_{ij} / \sum_i \sum_j x_{ij}$. A particular country c has comparative disadvantage in particular sector, s if $0 < RCA_{sc} < 1$ and it has comparative advantage if $1 < RCA_{sc} < \sum_i \sum_j x_{ij} / \sum_i x_{ij}$. Balance *et al* (1987) noted that it is possible to attach threefold interpretation to the Balassa's RCA index (cited in Benedictis *et al*, 2001)⁷. First, it provides a demarcation between countries that reveal a comparative advantage in a particular sector and those countries that do not. This is the most common interpretation. Second, it quantifies the sector specific comparative advantage enjoyed by one country with respect to any other country or set of countries. Finally, it gives possible cross-country and cross-sector rankings ordered according to the value of the index. In general, the RCA index seeks to

⁶ There are many versions of Balassa's RCA index. For extensive survey see for example Utkulu and Seymen (2004).

⁷ Such degree of freedom in interpreting the index emerges from the indirect nature of RCA based on post trade data. Hence, it is possible to give dichotomous, ordinal or cardinal interpretation to the index (Havrila and Gunawardana, 2003)

reveal whether a selected commodity is more important to a country's exports than it is for another designated trade partners.

Although the measure helps to estimate the RCA indices at various points in time and hence provides the RCA indices in absolute terms, Balassa (1965) also showed that such relative export measures could also be used to reflect changes in comparative advantage overtime. This would help to test the stability of national export patterns. We would take up this issue latter in this section.

Albeit it stands out as the most widely used revealed comparative advantage index, the pros and cons of Balassa's RCA index are still debated in the literature (Sevin and Civan, 2008). The most serious limitation of the Balassa index is that it turns out to produce outputs that are not comparable on both sides of 1(one) (Laursen, 1998). This is because the index ranges from zero to one if a country is said to have comparative disadvantage in a given sector, while the value of the index ranges from one to infinity if a country is said to have comparative advantage. Hence, the Balassa's measure suffers from the inherent risk of lack of normality. But, skewed distribution violates the assumption of normality of error terms in regression analysis and hence, producing unreliable t-statistics (Laursen, 1998). On the other hand, the upper bound of the Balassa index is not fixed. In particular, it inversely depends on the country's export share in the world exports. This reliance on the size may cause confusion in the interpretation of cross-country comparisons (Benedictis *et al*, 2001). In general, to put the idea more clearly, the Balassa's revealed comparative advantage index follows asymmetric distribution with a lower bound and a variable upper bound, it has a fixed demarcation value 1, a variable mean value, $\mu(RCA_{ij})$, and standard deviation $\sigma(RCA_{ij})$ (Benedicts *et al*, 2001).

At least in econometric sense, however, the Balassa's Revealed Comparative Advantage index (for that matter any revealed comparative advantage index) should be made symmetric.

Laursen (1998) proposed the following index normalization mechanism (see also Hoekman and Djankov, 1997):

$$RSCA_{ij} = \frac{RCA_{ij} - 1}{RCA_{ij} + 1} \quad (2.2)$$

where $RSCA_{ij}$ is Revealed Symmetric Comparative Advantage (adjusted RCA) and it ranges between 1 and -1. Hence, the method has the advantage of attributing changes below unity the same weight as the changes above unity (Hoekman and Djankov, 1997). Vollrath (1991), on the other hand, suggested taking the logarithm of the index to avoid the asymmetry problem. The likely problem with such normalization, however, is that the index would be undefined if the country's export in a given sector is zero (Laursen, 1998). Furthermore, small RCA values are changed to high negative values. For instance, a change in RCA from say 0.01 to 0.02 or vice versa has the same impact as a change from 50 to 100 (Hoekman and Djankov, 1997).

2.1.1.2 Alternatives to Balassa (RCA) Index: the Vollrath Index and the Lafay Index

As noted above, several measures can be proposed based on production, export, import and net trade to infer the existence of comparative advantage. Each measure has its own weakness. For instances, using commodity trade balance to measure comparative advantage may render the indices incomparable due to the inter-country differences in protection (Wadud, 2007). Comparing production costs pose similar problem due to the complexities involved in accessing comparable information (Wadud, 2007).

Vollrath (1991) introduced measures that enable the estimation of comparative advantage in an environment that is susceptible to various degrees of distortion. He in particular developed the idea of revealed competitive advantage and trade intensity indices. These alternative specifications of RCA include: the Revealed Export Advantage (RXA), the Revealed Import Advantage (RMA), the Revealed Trade Advantage (RTA) and the Revealed Competitiveness

(RC). The added advantage of these indices is that they are symmetric through the origin (Utkulu *et al*, 2004) and hence requiring no normalizations. Furthermore, they allow one to distinguish between specific commodity (country) and the rest of the commodities (countries) (Vollrath, 1991). This eliminates the possibility of country and commodity double counting. The revealed competitiveness index encompasses both supply and demand balance in it. Hence, it provides a better picture of actual comparative advantage of a commodity (or a country) (Vollrath, 2004). However, this measure is of dubious value if bilateral trade does not occur i.e. either import or export is zero.

Cheap-labor emerging economies like china and other East Asian economies tend to import technologically sophisticated components, perform low value added assembling activities and subsequently re-export valuable final goods to which they have scarcely contributed. In such instance the traditional Balassa (1965) index is of little significance. In an environment characterized by vertical fragmentation of production, hence, we need an indicator of RCA which is able to control the import-intensity of exports. Lafay (1992) index which is based on the net trade flows is therefore more appropriate to deal with the problem of fragmented production (Marconi *et al*, 2007). Another desirable feature of the Lafay index is that it is symmetric on both sides of zero and hence requiring no normalizations.

In general, the greater independence of measurement issues from the theory and hence the larger degree of freedom in the selection of specific index of RCA in applied works means that there is a need to be aware the implications that those indices convey (Benedictis *et al*, 2001).

2.1.2 The Stability of Export Specialization Patterns: The Galtonian Regression Model

As noted above, comparative advantage is a microeconomic concept focusing on industry-specific trade, explaining why one country might export labor intensive products while

another country might specialize in capital intensive ones (Adams *et al*, 2004). Comparative advantage as reflected by the RCA index is static concept indicating the export specialization pattern of a given country at a particular point in time. Nevertheless, in the medium to long run, despite the forces in international trade that tend to reinforce strengths and weaknesses in trade performances (Dalum *et al*, 1998), there are forces⁸ enabling sectors with initial low comparative advantage to improve and sectors with initial large comparative advantage to deteriorate. In particular, it could be the case that those sectors initially below the country average are above the average in the final year and vice versa. Hence, in addition to the revealing the comparative advantage of a given country at a point in time, it is of immense importance to reflect on where the country's export structure is heading.

Several techniques have been proposed to measure the stability of trade specialization patterns of a nation. The most easily interpretable technique is to calculate a simple correlation coefficient between the RCA indices for each country at different periods of time (see Hoekman and Djankov, 1997). This simple correlation would give an important insight to the change in export composition. This technique which is followed from the work of Pavitt (1989) was initially used to test the stability of technological specialization patterns at country level (Hoekman and Djankov, 1997). The idea is that high positive correlations between the indices indicate less change in the export composition (Hoekman and Djankov, 1997). Different, but related issue is the concept of shift in comparative advantage. Bander (2002) proposed the correlations of RCAs for a given sector between two different country groups over a period to be the appropriate measure of the systematic shifts in comparative advantage.

⁸Such forces include the expanded foreign market, increased foreign competition, policy induced restructuring of the economy, foreign direct investment, process of technological imitation, international trade in capital goods and components and etc (see for example Dalum *et al*, 1998). Pattern of comparative advantage can also change in the process of accumulation of physical and human capital that characterizes economic development (Balassa, 1979).

Negative correlation means that the loss suffered by one region is the gain of the other region⁹ and hence, indicating a systematic shift in comparative advantage (Bander, 2002).

The most widely applied technique in trade literature is what we call the ‘Galtonian Regression Method’. This method was initially developed by Hart and Prais (1956) and used in the context of specialization by Cantwell (1989) (see Dalum *et al*, 1998). Stability (the specialization trend) is tested by the following regression equation:

$$RCA_{ij}^{t_2} = \alpha_i + \beta_i RCA_{ij}^{t_1} + \varepsilon_{ij} \quad (2.3)^{10}$$

where the superscripts t_1 and t_2 refer to the first and the next period respectively. α and β are standard regression parameters and ε is the residual term. In this regression the dependent variable, the RCA at time t_2 for sector (commodity) i , is regressed against the independent variable which is the RCA in the previous year, t_1 . This regression equation can be estimated along two approaches: the country-wise and the sector-wise approaches. The country-wise approach tests whether countries are stable across sectors and whether they tend to become more or less specialized intra-country. On the other hand, the sector-wise approach tests whether specialization patterns tend to converge across countries, within the same sector (Dalum *et al*, 1998). As noted above the Balassa’s measure suffers from the inherent lack of normality and hence violating the normality of error terms in the above regression (Benedictis *et al*, 2001 and Dalum *et al*, 1998). Further, the Balassa’s measure gives more weight to the values above one, in regression analysis, compared to the observations below one (Dalum *et al*, 1998). Hence, the index should be made symmetric before used in regression (see for example Laursen, 1998, Benedictis *et al*, 2001 and Dalum *et al*, 1998). Therefore, the above

⁹ Note that the world trade is fixed in a given period of time.

¹⁰ It is imperative to note that nothing can be said about the determinants of the initial specialization pattern based on this equation (Dalum *et al*, 1998)

regression equation could be re-written in terms of the Revealed Symmetric Comparative Advantage as:

$$RSCA_{ij}^{t_2} = \alpha_i + \beta_i RSCA_{ij}^{t_1} + \varepsilon_{ij} \quad (2.4)$$

The size of β measures how stable the specialization pattern of a given country has been between the two periods. Very low value of β indicates higher degree of turbulence while values not significantly different from one show unchanged pattern of comparative advantage (Laursen, 1998 and Dalum *et al*, 1998). In particular, if $\beta > 1$ the country tends to become more specialized in sectors where it is already specialized and less specialized in sectors where initial specialization is low which implies that initial specialization pattern is strengthened. On the other hand, if $0 < \beta < 1$ it means that on average those sectors with initial low RSCA increase overtime while sectors with initial high RSCA decrease their values. In trying to make analogy with the convergence literature, Dalum *et al* (1998) termed the first case as β -specialization and the second β -de-specialization in the country-wise approach and β -divergence and β -convergence respectively in the sector-wise approach. In fact, it could be the case that $\beta < 0$ in which case the rank of the sectors reversed (Dalum *et al*, 1998).

One can also use the above regression equation to test whether the specialization changes or not. Cantwell (1989) argued that $\beta > 1$ may not be necessary condition to infer that the overall specialization pattern increased. Following Hart (1976), it can be shown that

$$\left(\sigma_{ij}^{t_2}\right)^2 / \left(\sigma_{ij}^{t_1}\right)^2 = \beta_i^2 / R_i^2 \quad (2.5)$$

Hence,

$$\sigma_{ij}^{t_2} / \sigma_{ij}^{t_1} = |\beta| / |R| \quad (2.6)$$

where σ is the standard deviation of the RSCA and R is the correlation coefficient from the regression.

The point is that the dispersion of the distribution is unchanged if $\beta = R$ while the degree of specialization has increased if $\beta > R$ (the dispersion has increased) (Dalum *et al*, 1998 and Laursen, 1998). Here also the analogy with the convergence literature is apparent, the situation being called σ -specialization in the country-wise approach (Dalum *et al*, 1998). If we have $\beta < R$, the dispersion has decreased and we call it as σ -de-specialization pattern in the country-wise approach. In the sector-wise approach the first case is called the σ -divergence pattern and the second σ -convergence pattern.

In general, to examine the dynamics of specialization patterns and the determinants of such patterns, which are the theme of this study, the concept of comparative advantage is central. Furthermore, the notion of measuring such specialization patterns and their dynamics is of immense importance. Specifically, to show how export specialization patterns are evolving and hence, to measure the stability of national export specialization patterns one needs the concept of Galtonian regression which in turn leads to the concepts of variation and dispersion in regression. Therefore, these techniques help to test whether countries are stable across sectors and whether they tend to become more or less specialized intra-country.

2.1.3 Some Stylized Facts on the Export Structure of Africa, the Primary Commodity Export and the Challenges to Industrialization

In most of its history, if not all, Africa played a role of exporting primary commodities and importing processed goods. In particular, most African countries rely on export of few primary commodities and export to few markets. Such commodities are characterized by extremely volatile prices, some commodities even experiencing swings from trough to peak in just a few months (Deaton and Laroque, 1992). Hence, dependence on the export of a narrow

range of primary products has left many African countries vulnerable to price shocks. For countries whose export earnings and GNP are dependent on these commodities, such volatility poses major problems both of macroeconomic and microeconomic policy (Deaton and Laroque, 1992). Furthermore, the long run commodity prices fall relative to the prices of manufactures i.e. the terms of trade of primary commodity exporters deteriorate over time. Such deterioration is owing to the fact that income elasticity for primary commodities is lower than those for the manufactures, so that the demand for the latter grows more rapidly than the former (Deaton, 1999 and Alemayehu, 2010). Alemayehu (2010) also noted that such deterioration could also be due to the flexi-price nature of the market where the commodities are sold, contrary to the fix-price oligopolistic market for the manufactured products. Furthermore, primary commodities are subject to synthetic substitutes.

Primary commodities are also characterized by limited scope for technological progress (Alemayehu, 2010). Similarly, economic development strategies based solely on raw commodities risk having a very limited effect on poverty levels since for instance, resources exploitation generate preciously few job opportunities for the low-skilled (Bamou and Adenikinju, 2006). Boom in commodity prices are also both curse and blessing¹¹. Attempts to industrialize on proceeds of commodity exports have been hampered by a Dutch disease which raise the prices of locally produced non-tradeables relative to locally produced tradeables, typically manufacturing and diverts production from the latter to the former. This reallocation can be a problem if diversification towards manufacturing is regarded as desirable in itself or if manufacturing displays increasing returns that are not available elsewhere (Deaton, 1999). In general, Singer (1950) argued against specializing in the production and export of primary commodities as it removes the secondary and cumulative

¹¹ *The revenue from commodity exports provides a potential source of investment funds. Even temporary price booms provide windfalls that, if wisely invested, can enhance future growth and development. Yet resource rich countries grow more slowly than resource poor economies and it is easy to write modern tragedies based on the stories of oil in Nigeria, coffee in Kenya, cocoa in Ghana or copper in Zaire (Deaton, 1999)*

effect of investment and it diverts developing countries to areas where the scope for technical progress is limited and worsening terms of trade prevail (cited in Alemayehu, 2010)

On the other end of the story, manufactured exports (and other non-traditional exports) are more capable than traditional primary exports in supporting sustained overall economic growth for several reasons (see Elbadawi, 1999 and Bamou and Adenikinju, 2006). Elbadawi (1999), provided three basic reasons why industrialization complement overall economic growth. First, compared to primary goods exports, manufactured exports are likely to grow faster when the global economy is expanding because their income elasticity of demand is higher. Szirmai (2009) specifically argued that as per capita incomes rise, the share of agricultural expenditure in total expenditure declines and the share of expenditure on manufactured goods increases (the Engel's law). Hence, countries specialising in agricultural and primary production will not benefit from expanding world markets for manufacturing goods. Second, due to the relatively higher price elasticities of demand and supply for manufactures compared to primary goods exports, the former are less susceptible to price variability. Finally, the prospects for dynamic productivity gains are much higher in the manufacturing sector. A transfer of productive resources to more dynamic sectors contributes to growth (Szirmai, 2009). Hence, in the medium to long run the role of traditional primary exports should be to facilitate export diversification. Similarly, Szirmai (2009) argued against the production and export of primary commodities on the ground that economies of scale, technological progress and linkage effects, which characterize the manufacturing sector, are less available in the sector. Capital accumulation is also more easily realised in spatially concentrated manufacturing than in spatially dispersed agriculture.

Notwithstanding the above arguments, Sarkar and Singer (1991) argued that the unit values of manufactures exported by developing countries deteriorate over periods (Maizels, 2000). Singer, in a review of his original work, elaborated the influence of technological capability

on the terms of trade of developing countries' manufactures, in which he argued that manufacturing firms in developed countries have a near monopoly of technical progress which could enable them bargain successfully (cited in Maizels, 2000). Maizels (2000) further showed that the manufactures terms of trade of developing countries with US deteriorated in the early days of the 1980s and has been trend less since then. He also provided a justification for such trend. Manufactured exports mainly consisting of labor intensive and resource based products are always sold in highly competitive world markets which operate very much as do the markets for primary products. Those same factors leading to deteriorating terms of trade for primary commodities result in the weak prices for the developing countries' manufactures (Goldstein *et al*, 2006). However, Maizels (2000) argued that, this result could not be used as proof for Singer (1971) hypothesis for major changes in the capability of developing countries have taken place since then particularly as regards to the information technology products. In fact Maizels' argument may miss the point because aggregate analysis such as this which is based on the whole developing countries could miss the fact that some countries such as those in Africa have built structure that has changed little since the 1970s.

Given the fact that African economies are linked to world economy as primary commodity producers and importers of processed materials, it is imperative to know what explain such trade patterns. Some authors use the HO theory to argue that the structure of African export shows the region's comparative advantage which is likely to change only slowly over the next few decades (see Wood and Mayer, 2001; Wood, 2003 and Mayer and Fajarnes, 2005). Wood and Mayer (2001) argue that Africa's export dependence on primary commodities is due to the combination of low levels of human capital and abundant natural resources. Nonetheless, some find it inadequate to advise African countries to specialize in the production and export of primary commodities based on the comparative advantage thesis while its validity is still debated in the literature (UNCTAD, 2008). Lall (2006) further argued that the most important issue for a country's export potential is not its static comparative advantage, but

what the country specializes in through developing its competitive advantage. Therefore, African countries might create dynamic comparative advantage rather than continue to enhance the existing division of labor (Alemayehu, 2010).

UNCTAD (2008) provide two general explanations for the low level of manufacturing production in Africa. First, manufacturing sector requires massive investment which, given the risky nature of the environment, is difficult to make in Africa. Second, Africa lacks the technological capabilities needed to set in motion a successful process of industrialization. Hence, lack of required technical skills to innovate and create new goods that are competitive in international markets explains the low manufactured export performance. Furthermore, poor governance structure and lack of support infrastructures such as road and electricity add to the cost of doing business and plays to the detriment of Africa's industrial development (Uche, 2009).

On the other hand, there are groups attributing the current export structure of Africa to its interaction with external world beside the impact of endowment. Alemayehu (2010) noted that a move from the production and export of primary export to processing of the same before the colonial era was interrupted by Europeans. Being determined by their commercial interest, the colonial policies required the colonies to supply raw materials. Hence, the same development was followed during the colonial period (Amin *et al*, 2007 and Alemayehu, 2010). Furthermore, the import liberalization policies of SAP played a good part in the formation of commodity exporting African economies. One obvious point from here is that had it not been for these external forces, Africa might have created its own comparative advantage in the labor intensive manufactured products. To take different perspective, such forces are also responsible for putting the current African export structure and problems associated with it in place.

The recent ADs' relation with Africa may also have important implication for the industrial development strategies of the continent. After their impressive economic performance, the ADs expanded their activities in to other developing countries (including Africa) in search of raw materials and market for their manufactured exports. In analyzing the trade impact of ADs on other developing countries, Kaplinsky (2006) distinguished between two dimensions of effects (see also Kaplinsky *et al*, 2006 and Kaplinsky, 2007, 2008). The first is the complementary-competitive dimension and the second is the direct and indirect effects. These dimensions viewed through the vector of trade give us, what Lederman *et al* (2008) stated as, the impenetrable cell phone with a task of getting in to it harder than one expects. Through the trade channel, ADs may provide sub Saharan Africa with appropriate capital goods and cheap intermediate inputs. Similarly, the prices of several consumer goods are falling due to increased ADs' competitiveness (productivity and marketing) which would enhance the welfare of consumers for a given quality. On the other hand, ADs' cheap export of consumer goods to SSA may displace production by indigenous firms.

Kaplinsky (2008) argued that the complementary-competitive axis of impacts is readily comprehended and widely recognized. The distinction between direct and indirect impacts is less widely acknowledged partly because the indirect impacts are difficult to measure (Kaplinsky, 2008). The indirect impact is the fact that the ADs' exports to the third markets may place intense pressure on the prices and the market shares of sub-Saharan export to the same markets (Alemayehu, 2006 and Kaplinsky and Morris, 2006). Furthermore, in the medium to long run, the increased primary commodity imports of ADs from elsewhere (including the sub-Saharan Africa), apart from its short term benefits through higher global prices, may lock African countries in the production and exports of primary commodities (Alemayehu, 2006 and Kaplinsky, 2008). In general, ADs' impact is widespread where most countries will be affected on several fronts, both directly and via substitute/complementary products, and that these effects may be reinforcing or offsetting. It is also non-marginal in the

sense that the ADs' impact will be felt on world market prices and not be limited to countries that trade directly with either China or India (Lederman *et al*, 2008). Furthermore, these impacts are contingent in the sense that they change over time, and vary in importance depending on factors such as location, resource endowment, trade links, and geo-strategic significance (Kaplinsky, 2007).

Although the current pattern of trade between ADs and Africa is consistent with resources endowment and hence, comparative advantage of the ADs (FAO, 2007), such trade pattern could have a deleterious effect on the industrial growth of the region. On one hand, the surge in commodity demand may increase the Africa's potential for the primary commodity export both directly and indirectly (Mayer and Fajarnes, 2005). This will re-deepen their specialization in the sector and reduce the manufactured export through the usual Dutch disease mechanism (and *Leamer triangle* mechanisms) (Coxhead and Jayasuriya, 2008 and Kaplinsky and Morris, 2006)¹². On the other hand, the cheap manufactured exports of ADs displace the manufactured exports of African countries in the third markets and in the domestic markets as well. In general, despite the ADs' developmental similarities with African countries, the structure of its economic and industrial cooperation with the continent mimics that of the Western nations (Uche, 2009) where exports of the primary commodities are encouraged and that of manufactured faces challenge. Hence, ADs' engagements with Africa may intensify the de-industrialization process initiated by the liberalization policies embedded in the Structural Adjustment Programmes (SAP) (Ajakaiye, 2006).

In general, as argued by Coxhead and Jayasuria (2008) the growth of China and India offer Africa countries both adjustment challenges (in some cases quite severe) and opportunities for growth. Although some argue that the volume of ADs' primary commodity imports are likely

¹² '*Leamer Triangle*' is an alternative framework used to analyze the impact of both the resource boom and commodity price volatility that the Asian Drivers tend to exert on resource-rich economies where non-commodity tradable activities are not developed (Goldstein *et al*, 2006)

to keep growing over the next two or three decades, the continent shouldn't left worse off ones the boom ends (Mayer and Fajarnes, 2005). Furthermore, ADs competition with the domestic industries in the local and third country market would have important implication on the feasibility of African countries industrial policy. Hence, African trade strategies should be re-thought in light of its engagement with ADs and policy response must be carefully tailored if Africa has to see bright future in industrial development. African countries should learn from their failed economic relationships with the West and have to develop and operate clearly defined industrialization programmes in its dealings with ADs.

2.2 The Empirical Literature: The Impacts of ADs on African Export Structure

ADs' integration into the world economy is one of the most important developments affecting the structure and evolution of the global system at the dawn of the 21st century. China has grown at a rate of nearly 10 per cent per annum, driven primarily by the expansion of modern, industrial, export-oriented sector over the last two or three decades (see Giovannetti and Sanfillippo, 2009; Greenaway *et al*, 2006 and Eichengreen *et al*, 2004). Similarly, India's economy is also booming although by less than that of China (7 percent per annum on average between 2000 and 2007) (Farooki, 2009). In spite of their relatively low levels of per capita income, therefore, these two countries stand out in terms of their growth rates and size (with about two-fifth of the world population and one-fifth of global income). Being developing countries, these new¹³ ADs are moving through a resource intensive stage of economic growth (Farooki, 2009). As such, their economic performance can exert a sizeable impact on global commodity markets, trade patterns, and the economic prospects of both developing and developed countries (FAO, 2007). In general, such economic ascendance of China (and India to some extent) in the last decades, has altered the rules of the game of international economic and political contest heralding a new 'Global Asian Era' (Kaplinsky, 2007).

Kaplinsky (2007) showed why, despite their structural differences, the ADs pose major and distinct challenges for developed and developing economies. First, given their sheer size, they could not grow without severe disruption to the global economy and hence requiring us to suspend the 'small country' assumption. In particular, the very high trade intensity of ADs' growth makes the big country effect prominent in its case. In 1990 the trade GDP ratio of China and India were 32 percent and 16 percent respectively and rose to 55 percent and 31

¹³ *In fact, Asia has been a remarkably dynamic region over the past four decades: different economies in the region have experienced rapid growth, beginning with Japan between the 1950s and the 1980s, and then several newly industrializing economies (see FAO, 2007)*

percent in 2002 respectively (DFID, 2005). Second, they combine low income and low wages with significant innovative potential. China overtook Japan to become the second largest investor in research and development in 2006 (Kaplinsky, 2007). Furthermore, China had a reserve army of unemployed, estimated at around 150 million compared to the 83 million people employed in the formal sector manufacturing in 2002 (Kaplinsky, 2007). By 2030 India, with reserve army of unemployed, is also expected to have larger population than China (Kaplinsky, 2007). Most importantly, the huge natural resource hunger and energy needs of China and India will in the future serve to place the issue of sustainability squarely back on the agenda of global politics and development policies (see Kaplinsky, 2007).

Given the sizable impact of the Asian Drivers, and hence not surprisingly, there has been a surge of interest in the implications of the rapid economic growth of the ADs for other economies in general and developing countries in particular. Several studies analyzed the impact of the ADs' (specifically that of China) on Africa (see for example, Jenkins and Edwards (2005), Goldstein *et al* (2006), Stevens and Kennan (2006), Broadman (2007), Zafar (2007), Alemayehu and Atnafu (2008) and Jenkins (2008) among others) and on other Asian countries (see for example Ianchovichina and Walmsley (2001), Ahearne *et al* (2003), Eichengreen *et al* (2004), Greenaway *et al* (2006)) through the trade channel. Several studies also empirically analyzed the ADs' impact on Latin American Countries (LACs) (see Ledereman *et al*, 2008 for extensive survey). In fact, less emphasis was put on the impact of India on other developing countries in the literature given the fact that India is not yet a large dynamic economy that could not experience growth without disruption to the global economy like China. China's contribution to global output is almost triple to that of India (Vidyarthi, 2008). Vidyarthi (2008) also noted that during the 1990-2004, India's import from Africa has risen at annual average growth rate of 14 percent while during the same period that of China was 26 percent and it rose to 48 percent annually between 1999 and 2004. Hence, Indian engagement with Africa has less significant implication compared to China and therefore,

India's engagement with Africa has been analyzed in quite limited way and almost negligible at policy level. The only study, to the knowledge of the author, which employs empirical methodology to analyze the impact of India on African countries is that of Alemayehu and Atnafu (2008).

The impact of ADs on Africa through the trade channel is a mixed blessing (Alemayehu, 2006 and Kaplinsky, 2007). Several studies analyzed the issue using different methodologies. One strand of the literature handles the issue by identifying the degree of overlap of China's export with other developing countries. Jenkins and Edwards (2005) by employing the Export Similarity Index (ESI) found the export overlap with South Africa, Kenya, Namibia and Senegal in the third market and hence, the possible competition from China. Goldstein *et al* (2006), by applying the same method, found similar result, the losers in this case being South Africa and Kenya. These are the two countries with most developed manufacturing base. Goldstein *et al* (2006) augmented their conclusion by calculating manufactured RCA index for China and India and African countries which also indicates similar results. Their result also points to the fact that the export similarity index is higher for India. This is probably the case that India is a significant exporter of mineral and fresh food which African countries also export. Stevens and Kennan (2006) approached the issue by calculating the export-import overlaps at product level. In estimating the impact of China and India on African countries' trade balance, they draw a tentative list of African losers and winners from China and India's growth surge. Contrary to the above results, their study showed that the trade overall balance effect for all African countries in their sample is positive.

In fact, as argued by Sanfilippo (2006), all these studies share common shortcomings. With the exception of the study by Stevens and Kennan (2006) the data used are too aggregated and, hence, may fail to account for countries whose exports are widely specialized at the product level. Furthermore, the traditional measures of export similarity might be misleading

when China (a big country) is compared with smallest countries whose exports are often very concentrated on few products (Stevens, 2008 and Sanfilippo, 2006). In addition, there are two problems with the indices of export similarity (Lederman *et al*, 2008). First, they fail to capture the importance of each product in world markets i.e. both countries (regions) can have very different shares in products that are heavily traded in world markets, and very similar ones in products that are not heavily traded, hence understating the degree of similarity between the exports of two countries (regions). In fact, Jenkins and Edwards (2005) pointed out that the export similarity index is a crude measure of the degree of competition between countries and a more direct indicator is the proportion of a country's trade that is threatened by the drivers' export. Second, since it focuses on exports only they fail to capture the growing intra-industry trade (Jenkins and Edwards, 2005).

The issue is also amenable to the RCA analysis. RCA analysis of Goldstein *et al* (2006), for instance, show competition with African leather (Burkina Faso, Ethiopia, Kenya and Mali), clothing (Lesotho and Malawi) and textiles (Tanzania) exporters. However, it is imperative to note in passing that, RCA analysis ignores competition in sectors where African countries have not yet any RCA but which might nonetheless constitute opportunities for diversification away from traditional exports (Goldstein *et al*, 2006). Furthermore, RCA is a crude indicator as it is based on aggregate data.

Jenkins and Edwards (2005) used alternative method to analyze the impact of China and India in the context of trade poverty linkages. They identified the products in which these countries have been increasingly significant competitors in the third markets regardless of the fact that China and India have comparative advantage or not in the products. Then, they examine whether these products represent major exports of African countries and whether these products are labor intensive in nature. The last task helps to identify the poverty implications of ADs' engagement in the global economy. Competition (for world export shares) analysis of

Jenkins and Edwards (2005) shows China being a threat to African countries such as Lesotho (which faced competition for 89.1 percent of its exports to the third markets), Zambia (for 82 percent of its export to the third markets), Mozambique (73.4 percent of its export to the third markets), Malawi (64 percent of its export to the third market), Namibia (55.4 percent of its export to the third market and South Africa (54.4 percent of its export to the third market). In Lesotho the exports that faced competition from China and India are mostly (80 percent) labor intensive manufactures. As a result their competition would have strong impact on poverty (Goldstein *et al*, 2006).

Jenkins (2008) instead employed the static and dynamic index of competitive threat at SITC 3 Jenkins (2008) argue that the extent to which a country faces a competitive threat from China depends on the proportion of its total exports accounted for by products in which China is globally competitive, not on the overall similarity of its export structure to that of China. A country which has a high share of its exports in such products is threatened by Chinese competition even if the products concerned account for a relatively small share of China's total exports indicating low export similarity. This is the concept of static competitive threat. Alternatively we can also identify those products where China's exports are growing more rapidly than world trade as those in which other countries' exports are facing dynamic threat. While the static index does not lend support to the high competition in exports, the dynamic index of competitive threat shows rising threat for all African countries in the sample, the immediate losers being Mozambique, South Africa and Uganda (Jenkins, 2008).

Few studies applied the econometric methodology to analyze the impact of ADs on the export structure of other developing countries (see Ianchovichina and Walmsley (2001), Ahearne *et al* (2003), Eichengreen *et al* (2004), Greenaway *et al* (2006) and Alemayehu and Atnafu (2008)). Alemayehu and Atnafu (2008) employed gravity model to see whether ADs' export displaced African manufacturing exports to the third market. Their study showed that China

and India affect the exporters of Africa differently, with Niger, Zambia and Burkina Faso being the three most vulnerable exporters followed by Ghana, Algeria, Gabon, Cote D'Ivoire and Kenya. Further, their result indicate that the impact of China vary across time. They report that while the exports of China compete with the export of Africa, that of India tend to complement it before 2000 and the overall impact of both countries was complementarity during the latter years (Alemayehu and Atnafu, 2008). They also used the Flying Geese Theory to see whether there is dynamic comparative advantage in African manufacturing of clothing and accessories and hence, whether there is evidence of shifting comparative advantage from the ADs to African countries. They calculated the spearman's rank correlation coefficient between the RCA index vectors of thirteen African exporter countries on one hand and China and India on the other to test whether comparative advantage is shifting from China and India to Africa. Their result showed that Niger, Madagascar and Kenya are moving in the same direction as China and India. Furthermore, only South Africa and Kenya were gaining comparative advantage in declining industry and in industry with growing demands respectively (Alemayehu and Atnafu, 2008).

Relatively a bulk of studies emphasized the impact of ADs on other Asian countries. Ahearne *et al* (2003), in analyzing the impact of China on the NIEs and some ASEAN members, regress the growth of these countries' exports on the growth of foreign incomes and the change in the country's real exchange rate by adding China's real export growth as an additional regressor to these export equations. China's export carries positive sign suggesting complementarities between its exports and those of its Asian neighbors. Contrary to this result Ianchovichina and Walmsley (2001), by calibrating and simulating multi-country, multi sector model in the context of China's WTO accession, showed that the exports of Vietnam, Philippines, Thailand, Indonesia and Malaysia were displaced by that of China. In fact, these countries export those goods in which China has comparative advantage and hence competitive i.e. labor intensive manufacturing exports such as textiles and apparel.

Eichengreen *et al* (2004) investigated the issue by employing Gravity Modeling Approach. Their result indicate that the impact of China on exporters of capital goods and consumer goods and hence on Asia's more and less developed countries is different; the less developed Asian countries being crowded out by China in the third market. Similarly, Greenaway *et al* (2006) showed that over the period 1990-2003, China's export surge did appear to displace its neighbors' exports to third markets. Specifically, they argue that a percent increase in China's exports to the third market leads to 0.07 percent drop in Asian countries' export to the same market (Greenaway *et al*, 2006). The study further showed an even higher displacement effect (0.17 percent) when China and Hong Kong are combined than when export of China is narrowly defined (Greenaway *et al*, 2006)¹⁴. Similar to Eichengreen *et al* (2004), Greenaway *et al* (2006) analyzed the question for which group of countries the displacement effect is severe. China's export carries negative but insignificant coefficient for low income Asian countries (Greenaway *et al*, 2006), reflecting the impact of quota limitation on the textile and apparel export of China to developed countries market. For high income countries the coefficient is negative and significant (Greenaway *et al*, 2006) supporting the view that China's comparative advantage has changed, and that it is moving up the technology ladder. The other point that warrants mention is that the study also identifies how the displacement effect varies between advanced and developing country importers. The result shows that China's competitive threat is much intense in the developed country market.

The weakness of the literature regarding the trade channel is now apparent. Almost all studies tend to focus on the impact of the ADs on the future of Africa's industrialization by pointing to the possible impact of the drivers' labor intensive manufactured export to the third market on the African export to the same market. Notwithstanding the bias in literature, a point of equal importance is the possible danger of the drivers' voracious appetite for primary

¹⁴ A significant portion of Chinese export use not only China's labor but also Hong Kong's management and distribution skills (Greenaway *et al*, 2006)

commodities in locking developing economies in the production and export of these commodities in the perpetual manner. Furthermore, the impact of ADs' competition in the domestic market on potential local producers is sizable. Hence, as noted by Kaplinsky (2008), there is potential danger of emphasizing the direct and measurable impacts and overlooking the indirect and difficult to measure ones. The fact, however, is that there is cases where the indirect impacts are more significant than the direct impacts.

For instance, between 1999 and 2005 China accounted for nearly two-thirds of the growth in global main metals consumption compared to only 41 percent before 1999, as its volume growth more than doubled, increasing by 17.0 percent per annum. (Streifel, 2008). Specifically, between 2000 and 2003, China's share of the increase in global demand for aluminum, steel, nickel and copper was 76 percent, 95 percent, 99 percent and 100 percent respectively (Kaplinsky, 2008). This expansion in Chinese commodity imports has been closely reflected in the global prices of many hard commodities. For example, Kaplinsky (2008) showed that between 2001 and 2004, copper prices more than doubled. Hence, it is in the metals in which China is a net importer that the prices increased most. India is also important consumer of several commodities. It ranks fifth in overall energy consumption and third largest consumer in coal (Streifel, 2008). Similarly, it ranks seventh or eighth for aluminum, tin and zinc consumption, and eleventh for copper. In agriculture, where it has a much greater presence, it is the largest consumer of sugar and tea and the second largest consumer of wheat, rice, palm oil and cotton (Streifel, 2008).

Concerning oil and gas, the ADs are increasingly turning toward SSA countries, whose risks and challenges have caused it to be overlooked by the West. China's import of crude oil from Africa surged from \$258.19 million in 1995 to \$38.8 billion in 2008 which is a significant increase. Similar trend could be observed for other commodities. Although the impact on agricultural commodities has been more recent, it has been no less significant (Kaplinsky,

2008). FAO (2005) employed GTAP model and projected the agricultural imports of China from the rest of the world to double between 2001 and 2020 (cited in FAO, 2007). Hence, China's increased import demand pushes up world market prices and leads to increases in the production of foods and feeds in all modeled regions (FAO, 2007). In general, ADs' growth (specifically that of China) is commodity intensive in the sense that those sectors which experienced above average growth such as infrastructure, construction and manufacturing are commodity intensive in nature (Farooki and Kaplinsky, 2009). Such commodity demand surge of the ADs, despite its short term positive income effects, may have adverse long term developmental consequences if it locks developing countries in the production and export of primary commodities.

The ADs commodity demand boom can also result in what we call 'the Dutch disease effect'. Resource boom can take place in three ways (Corden, 1984 cited in Goldstein *et al*, 2006): first, there can be exogenous technological progress in the booming resource sector; second, the country can see a windfall discovery of some natural resources; and third, there can be an exogenous rise in the world price of natural resources exported by a country. The last case is prominent in Africa following the ADs' integration to the world economy. A resource boom (rising commodity prices) will affect the economy through the '*resource movement effects*' where labor shifts to the booming sector (the resource sector) and away from the non booming tradable sector (the manufacturing sector) and '*the spending effects*' where non booming tradable sector contracts due to the real exchange rate appreciation. These two effects combined may result in the fall of the production and export of manufacturing sector and the expansion of the non tradable sector if the second effect is stronger than the first effect (Goldstein *et al*, 2006).

Alemayehu (2002), on the other hand, argue for the potential Dutch disease effect of the resource boom through inflation. In the context of the dependent economy model, switching

of demand from the traded to the non-traded sector may entail a rise in price of domestic (non-traded) goods with its subsequent supply response (Alemayehu, 2002). However, Goldstein *et al* (2006) argued that manufacturing and agricultural processing are underdeveloped in Africa for the Dutch disease to become serious policy issue¹⁵. In general, though the commodity boom favors some SSA economies, it poses very severe problems of economic management. Boom in (hard) commodity exports has been a major factor in driving the appreciation of the exchange rate in South Africa which made it difficult for its manufactured exports (not just clothing and textiles, but also wooden furniture and other low-tech and labor-intensive products) to compete in international markets (Kaplinsky and Morris, 2006). Such boom can also be associated with a variety of negative social and environmental outcomes representing what is known as ‘the paradox of plenty’, Democratic Republic of Congo being the important case in point (Guenther, 2008).

Furthermore, cheap manufactured exports of China and India flooded the domestic market and displaced the domestic industries in several countries such as Ethiopia (foot wear industries), South Africa (textile and apparel) and Zambia (textile industries) (see for instance Tegegne, 2007 and Edwards and Jenkins, 2006). Edwards and Jenkins (2005) argued that Chinese and Indian imports could increase their share of total African imports or could be additional to the existing imports. The latter case is damaging to the local manufacturing sector. From the sample of countries analyzed by Jenkins and Edwards (2005) only in Nigeria, where less than 50 percent of the increase in Chinese imports is due to the increase in their share in total imports, Chinese have displaced domestic manufacturing firms. However, as argued by Goldstein *et al* (2006), their analysis is carried out at an aggregate level and is based on a relatively ad hoc criterion as a result of which it offers little evidence of competitive pressure exerted by Chinese and Indian imports.

¹⁵ Rather we may need another framework to study the impact of resource boom and commodity price volatility exerted due to ADs rise. This leads us to the concept of the Leamer Triangle (Leamer, 1987 cited in Goldstein *et al*, 2006)

In general, the damage to African industrialization is not only a problem for the present but also affects future growth strategies. First, the ADs' commodity demand increase, despite the temporary windfall gain for African countries, may lock them in the traditional export sectors with its long term developmental consequences. Second, industries such as clothing, furniture and shoes have proved to be important stepping-stones for industrial development in other countries, including in the AD economies themselves (Kaplinsky and Morris, 2008). If these stepping stones are blocked by competition (directly or indirectly) from the ADs, it is difficult to see a future for African industrialization in the global economy (Kaplinsky and Morris, 2008).

In fact, the impacts of ADs' cheap manufactured exports are not all negative. Most of the least developed countries of Africa such as Lesotho, Kenya and Swaziland depend on the cheap Chinese fabrics for their apparel exports (Kaplinsky and Morris, 2006). Consumers in SSA have also been the most favored by the cheap Chinese manufactured exports. For instance in South Africa, despite the increase in the overall price index by 30 percent between 2000 and 2005, that of clothing fell by 5 percent (Kaplinsky, 2008). Chinese manufactured competition also forced some local producers to upgrade their competitiveness in Ethiopia (Tegegne, 2007).

Further, cheap manufacture exports of ADs along with their commodity demand surge tend to undermine the fact that developing countries are characterized by deteriorating terms of trade, one of the established wisdoms of international trade. In their early path breaking works Prebisch (1950) and Singer (1950) argued that the developing countries' terms of trade tend to decline due to several reasons. Those products exported by developing countries are subject to price squeeze due to low income-elasticity demand and price-elasticity demand. They are also subject to synthetic substitutes and hence falling demand (Kaplinsky, 2006). The growth surge of the drivers along with the outward oriented nature of the growth and their 'large

country effects' made the impact of the drivers' presence in the global economy a significant set of factors that tend to disequilibrate the past patterns of price formations (Kaplinsky, 2006 and Kaplinsky, 2008).

Specifically, the impact of the drivers on the global prices of traded products is double edged: decline in the prices of manufactured exports sourcing from the drivers and the increase in prices of primary commodities demanded by the drivers. Kaplinsky (2006) tried to track the product prices using disaggregated trade data at 8 digit HS level. He showed that out of 151 major product groupings in almost one-third of the sectors, the price of Chinese-origin products fell compared to only in one-quarter of the sectors in low income economies. Hence, Kaplinsky (2006) concluded that the greater the participation of China in the global product markets, the more likely the prices fall. Similarly, China and India have been and are the key drivers of the commodity price rise since the 1990s which involves all the three group of commodity sector: hard commodities, fuels and soft commodities (Kaplinsky, 2008). In fact, these changing terms of trade are likely to be sustained for a much longer period of time (see Kaplinsky, 2008). Zafar (2007) provides quantitative analysis of China's impact on the terms of trade in SSA for the period 2000-2005. By calculating the China's impact on the terms of trade for each country, the study categorized SSA countries as winners (oil exporters and resource rich countries), mixed winners-losers (resource-rich but oil importing countries) and losers (oil importing and textile exporting countries). In particular, countries such as Nigeria, Chad, Equatorial Guinea, Gabon, Congo, Angola, and Zambia and to a lesser extent, Mauritania, Mali, Guinea, Democratic Republics of Congo and Sudan have seen terms of trade gain. On the other hand, Guinea Bissau, Cote d'Ivoire, Swaziland, Kenya and Djibouti suffered net losses. For some other countries gains from higher priced non fuel commodity exports have been offset by higher oil bill (IMF, 2004 cited in Goldstein *et al*, 2006).

In general, the global engagement of ADs (particularly China) require us to suspend the prevailing wisdom of deteriorating commodity terms of trade with respect to manufactures since the historic patterns of relative price movements have begun to alter. This has important implication for development strategy in developing countries in general and SSA in particular.

Another channel of interaction of ADs with Africa is the flow of foreign direct investment (FDI). Benefiting from the technological diffusion of the western multinationals which established their production and assembly plants in China, local manufacturers established their own Chinese firms whose global aspirations soon became apparent (Corkin, 2006). Chinese FDI is qualitatively different in kind from European and North American sourced FDI (for extensive surveys see Kaplinsky *et al*, 2006, Kaplinsky, 2007 and Goldstein *et al*, 2006). It is argued that Chinese direct investment in Africa is driven primarily by the need to secure key commodity and energy assets as well as capturing untapped markets (see Alemayehu, 2006 and Ajakaike, 2006). Goldstein *et al* (2006) also showed that 50-80 percent of Chinese FDI in Africa is in resource exploration and natural resource rich countries. Hence, the industrial priorities of Chinese firms in Africa are manufacturing (textile industries) and the resource exploitation although agriculture and services are also the sectors of their interest. For instance, between 1979 and 2000, manufacturing and resource extracting industries accounted for about 74 percent of total capital invested in Africa (UNDP, 2007). The study by Alemayehu and Atnafu (2009) confirms this result where over 60 percent of Chinese investments in Ethiopia are concentrated in manufacturing sector. Alemayehu and Atnafu (2009) noted that such FDI flows in Africa are more plausibly explained by the Eclectic Approach of Dunning (1988, 1998 and 2000)¹⁶.

¹⁶ According to this approach, foreign based multinationals (i.e. FDI) could be identified either as market seeking, efficiency seeking or strategic asset seeking FDI (Dunning, 2001). The UNCTAD's typology of motives, on top of these three, adds resource seeking as the fourth fundamental motive (Asche and Schuller, 2006)

Alemayehu (2006) also argued that Chinese sourced FDI are also driven by the desire to exploit preferential markets (such as AGOA) which are accessible to African countries. In addition to getting direct access to market and securing natural resources bases, Chinese firms are also motivated to invest directly in the continent to circumvent the import quota imposed on Chinese products (UNDP, 2007). This is particularly true in the cases of textiles and industrial products. Alemayehu and Atnafu (2009) showed that 96 percent of Chinese firms operating in Ethiopia sell their product in Ethiopia while 56 percent of them source their inputs from Ethiopia which suggests that these firms are market and resource seeking in nature.

With access to cheap (and often subsidized) long term capital, the Chinese firms operate with distinctive time-horizons and are less risk-averse than their western counterparts (Tull, 2006 cited in Kaplinsky, 2006). They often operate abroad as a component of a broader strategic thrust. This is apparent from the fact that Chinese aid and FDI are often linked to resource rich countries. In sum, the ADs' direct investments are linked to strategic objectives, often focused on long term access to raw materials and closely bundled with Chinese aid (Kaplinsky *et al*, 2006). Historically, the western and the Japanese FDI in SSA have come from privately-owned corporations and focused on profit maximization, generally with relatively short time-horizons. Contrary to their western counterparts, much of Chinese FDI in SSA comes from firms which are either wholly or partially state-owned and operate with much longer time-horizons (Kaplinsky *et al*, 2006). Furthermore, Chinese firms are characterized by low margins, exclusive employment of low paid Chinese staffs, use of Chinese materials with very little local sourcing, use of standard designs and less attention to environmental impacts (Kaplinsky *et al*, 2006)

What is the likely impact of such pattern of FDI flows from China? One obvious benefit of FDI is transfer of technology to the local firms. Joint ventures with foreign firms may result in

the provision of intermediate inputs, know-how, equipment, or a variety of services ranging from design, to production and management techniques, to distribution and marketing (Hoekman and Djankov, 1997). However, several reasons may cast doubt on this fact regarding the FDI flows from China. Most of Chinese sourced firms are not willing to form joint ventures with the local firms and sub-contracting to local companies is relatively small (Asche and Schuller, 2006). In their study, Alemayehu and Atnafu (2009) showed that 90 percent of the Chinese firms in Ethiopia do not prefer to work in a joint venture with Ethiopian firms due to skill gap, working attitude and cultural difference. Complaints run against the lack of technological and human resources development impact of Chinese telecoms investment in Nigeria (Ajakaiye, 2006). Similarly, Chinese firms' contribution to local employment creation is also low. Several sources showed the mass influx of Chinese workers where for example up to 20,000 workers are employed in housing construction in Algeria alone (Asche and Schuller, 2006). This is basically because the Chinese labor is more skilled, more disciplined and hence, more productive than the local labor (Alemayehu and Atnafu, 2009). Furthermore, there is also communication difficulty between the Chinese workers and the local labor (Kaplinsky *et al*, 2006). Hence, in most of the Chinese financed projects imported Chinese workers are extensively employed making the possibility of technology transfer very low.

Several points deserve mention about the Chinese FDI from the above facts. First, given the fact that Chinese FDI is resource seeking, it hinders the expansion of local firms and industries that might potentially become exporters. Resource seeking FDI which targets the host country's cheap labor and raw materials may also discourage the development of the country's dynamic comparative advantage. Second, Chinese FDI is also as away to circumvent import restrictions and hence, production solely targets the domestic markets which would have deleterious effect on local producers. Finally, contrary to the FDI flows from the traditional sources, the Chinese FDI effect to the local technology transfer is very

low, given the fact that Chinese companies are rarely willing to form joint ventures with the local firms. In general, therefore, such FDI flows from China would have little or no effects on the diversification of export structure of Africa in the sense that it supports the traditional export structure of the region.

To sum up, several studies analyzed the trade and FDI impacts of the ADs on sub-Saharan Africa. In particular, these studies pointed to the impacts of China and India's relations on the future of Africa's industrialization strategies. Specifically, they tried to analyze the whether China and India are competing with the export of sub Saharan Africa in the third markets (mainly US and the EU). Furthermore, they analyzed the impacts of imports from the ADs on the local potential producers. These studies are, however, far from complete in their analysis of the ADs' impacts on the future of African industrialization. A point of equal importance in this context is the possible impact of the ADs' growing commodity imports and FDI flows on the future industrialization strategies of the continent. In other words, in the medium to long run, ADs' growing commodity demand and FDI flows, apart from their short term complementarities, could have long term developmental consequences on African countries. This study which is initiated with the task of exploring this neglected area would try to subject this point to formal analysis.

CHAPTER THREE

3. The Methodology

In the previous two chapters an attempt to place the issue in broader industrial development challenges of Africa as well as issue of trade specialization patterns is made. Specifically, theoretical issues pertaining to the measurement of the export specialization dynamics are raised. The literature on the impact of the ADs' growth spurt on other developing countries is also reviewed. In this section the method of analysis would be presented. Thus, the rest of the chapter is organized as follows. In section 3.1 the non-parametric test method of export specialization dynamics would be discussed. In section 3.2 the theoretical framework of the study would be presented. The empirical model of the study would also be specified and the expected results would be outlined. Data and data sources are discussed in the final section of the chapter, i.e. section 3.3.

3.1 Export Specialization Patterns and Stability of Export Structure: Where is Africa Heading?

In theory, the export specialization patterns of a given country may remain stable for a significant period of time owing to several factors. Given the path dependent nature of technology (see Ruttan, 1997, Dalum *et al*, 1998 and Laursen, 2000) and the close relationship between trade specialization and technological specialization (Dalum *et al*, 1998 and Laursen, 2000), it is expected that trade specialization pattern remain stable at national level over long periods. Models based on the vertical innovative linkages (i.e. user-producer relationships) also predict the export specialization patterns to be stable given such relationships are durable (Lundvall, 1988 cited in Dalum *et al*, 1998).

The Krugman (1987) model of dynamic comparative advantage also predicts stability of specialization patterns of countries given the presence of economies of scale. In Krugman (1987) model, the index of cumulative experience determines the level productivity of resources in each sector and each country and creating economies of scale at industry level. Hence, once specialization is established (for example by chance or by policy target), the model predicts that, it remain unchanged with changes in relative productivity acting to lock the pattern in further. In the dynamic equivalent of Krugman (1987) model, dynamic scale economies arising from learning by doing would lock the country in the initial pattern of specialization. Lucas (1988), Grossman and Helpman (1991) and Redding (1999) showed that in the presence of dynamic scale economies the long run trade pattern is fully determined by initial comparative advantage (cited in Brasili *et al*, 1999). In general, theoretical models arising from these grounds are along the line of the argument that self-reinforcing mechanisms are prominent in international trade specialization (Brasili *et al*, 1999) and predict the export specialization patterns to be stable over a long period of time. In fact, these arguments are of less significance in developing countries such as Africa where a significant proportion of the exports constitutes primary commodities. However, in such countries one can also predict high degree of stability in export specialization patterns from a different perspective. In developing countries the specialization patterns may remain stable for a significant period of time as long as the endowment patterns are not altering and self reinforcing mechanisms are apparent.

On the contrary, one can also predict higher degree of turbulence in the specialization patterns in an economy with expanding per capita income and characterized by technology based diversification (Pasinetti, 1981). Specialization pattern might also incrementally change due to the creation of new backward and forward linkages possibly to the extent of the creation of new development blocks (Dahmen, 1988).

Following the work of Balassa (1965) on measuring specialization patterns, the export specialization of a given (African) country is revealed by the Balassa's Revealed Comparative Advantage (RCA) index. Despite the fact that it overlooks the aspects of domestic consumption and value added processing (the fragmented production)¹⁷, the RCA index is a meaningful gauge for measuring the relative strength of export specialization for primary commodity exporting countries. However, RCA index is static concept indicating the export specialization patterns of a given country at a particular point in time. Hence, to see what is happening to the export structure of African countries in the medium to long run, one needs to devise a technique that shows the dynamics of the comparative advantage. This study adopts the Galtonian Regression Model to test the stability of export specialization patterns of African countries. This model, which is obtained by regressing the RCA index on the previous year RCA index, is the most widely applied technique in the empirical literature (see Dalum *et al*, 1998, Laursen, 2000 and Benedicts and Tamberi, 2001). The model is given as:

$$RCA_{ij}^{t_2} = \alpha_i + \beta_i RCA_{ij}^{t_1} + \varepsilon_{ij} \quad (3.1)$$

where the superscripts t_1 and t_2 refer to the first and the next period respectively and i and j refer to sector i and country j respectively. The Balassa's RCA index ranges from zero to one if a country is said to have comparative disadvantage in a given sector while the value of the index ranges from one to infinity if a country is said to have comparative advantage. Hence, due to the fact that the Balassa's measure suffers from the inherent risk of lack of normality and that such skewed distribution violates the assumption of normality of error terms in regression analysis, the index should be made symmetric at least in regression analysis (Dalum *et al*, 1998). In this study, following Laursen (2000), the index would be normalized as: $(RCA_{ij}-1)/(RCA_{ij}+1)$. This measure is labeled as Revealed Symmetric Comparative Advantage (adjusted RCA) (RSCA) index and it ranges between 1(one) and -1(negative one).

¹⁷ In such cases the Lafay Index (LI), which take the fragmented production in to account, is appropriate.

The index attributes changes below unity the same weight as the changes above unity (Dalum *et al*, 1998). However, in the main model of this study the index is simply normalized by taking its natural logarithm¹⁸. This is because, the above normalization mechanism generate negative values which are undefined when taking logarithms. Re-writing the above equation in terms of the symmetric index:

$$RSCA_{ij}^{t_2} = \alpha_i + \beta_i RSCA_{ij}^{t_1} + \varepsilon_{ij} \quad (3.2)$$

The magnitude and sign of β show the stability of the specialization pattern of a given country for a given sector between the two periods. Values of β not different from one indicates unchanged export structure and vice versa. In particular, if $\beta > 1$ the country tends to become more specialized in sectors where it is already specialized and less specialized in sectors where initial specialization is low which implies that initial specialization pattern is strengthened. In making analogy with convergence literature, Dalum *et al* (1998) termed the situation as the β -specialization and vice versa in the country-wise approach to the Galtonian regression method and β - divergence pattern and vice versa in the sector-wise approach. Following the arguments of Cantwell (1989), $\beta > 1$ may not be necessary condition to have re-deepening specialization pattern since it can only show the degree of association between the first and the second period specialization patterns. In other words, it doesn't show the degree of change in export specialization pattern. From the above regression, Hart (1976) showed that¹⁹

$$\sigma_{ij}^{t_2} / \sigma_{ij}^{t_1} = |\beta| / |R| \quad (3.3)$$

¹⁸ The skewness and kurtosis test of normality for this index is provided in Appendix C.3

¹⁹ The derivation of the model is shown in Appendix B.2

where σ_{ij}^2 and σ_{ij}^1 are the standard deviations of the export structure in the first and second year respectively and R_i is the correlation coefficient from the regression. The degree of specialization has increased if $\beta > R$ (the dispersion has increased) (Dalum *et al*, 1998 and Laursen, 2000). This situation is termed as the σ -specialization pattern and vice versa in the country-wise approach and the σ -divergence pattern and vice versa in the sector-wise approach (Dalum *et al*, 1998). Hence, if the ratio $|\beta_i|/|R_i|$ is greater than one (>1) for a given country (sector), it means that the initial specialization pattern of the country (in the sector) is strengthened. We will examine the sensitivity of the analysis to the method used by applying both the country and sector wise methodology. The country-wise approach tests whether countries are stable across sectors and whether they tend to become more or less specialized intra-country. On the other hand, the sector-wise approach tests whether specialization patterns tend to converge across countries, within the same sector. Hence, both methods are adopted to see whether they point to the same result (Dalum *et al*, 1998).

3.2 Theoretical Framework and Model Specification

Production (and trade) patterns around the world exhibit tremendous heterogeneity and specialization. On top of the preceding views on the stability of export specialization patterns, arguments on what accounts for such specialization patterns are also debated in the literature. Relatively the oldest theory regarding this issue is the theory of comparative advantage. The Ricardian and Heckscher-Ohlin (HO) theories are the two workhorse models used to explain this specialization. The Ricardian model of international trade predicts that countries specialize in goods in which they hold the greatest relative advantage in productivity of factors. The HO model ignores differences in productivity of factors across industries and assumes that all countries possess the same production function in a given industry. The HO model predicts that countries capture larger shares of production and trade in commodities

that intensively use their relatively abundant factors²⁰. A country's share of world production of a commodity is inversely related to its relative production cost with the low cost producer capturing larger share. Since every country has access to the same production technology by assumption, the only causes of production cost differences are factor price differences which in turn is dictated by the relative factor abundance. Countries therefore capture larger shares of world production and trade in commodities that intensively use their relatively inexpensive factors. HO model, in general, asserts that differences in comparative advantage come from differences in factor abundance and in the factor intensity of goods (see Debaere, 1998 and Alemayehu, 2010).

Even though both theories have equal importance in empirical literature (see Leamer, 1995 and Morrow, 2008), the HO model is the dominant comparative advantage theory in modern economics (Alemayehu, 2010). Given the fact that technology is fluid among the trading nations (Leamer, 1995 and Alemayehu, 2010), productivity difference ceases to be the source of comparative advantage. Furthermore, the HO model explains the trade relations between countries (or group of countries) with different factor supply ratios (Leamer, 1995)²¹. Hence, HO model provide strong theoretical explanations for developing countries' trade with the rest of the world. Therefore, in setting out to explain the patterns of international trade by reference to inter-sectoral differences in factor intensities and inter-country differences in factor endowments, the HO theory posits the existence of a well-defined relationship among trade flows, factor intensities, and factor endowments (Balassa, 1986). As a result, the way to use and measure the accuracy of the model is to obtain direct and independent measures of all three concepts: trade flows, factor intensities, and factor endowments (Leamer, 1984).

The result that trade pattern is dictated by relative factor abundance and factor intensities is apparent in a simple Heckscher-Ohlin-Vanek (HOV) model. The HOV model, which is a

²⁰ *There are two criteria to define factor abundance: the price and the physical criteria (see Alemayehu, 2010).*

²¹ *The trade relation between developed and developing countries is a good example in point.*

generalization of the HO model, states that a capital abundant country exports capital services and vice versa (Trefler, 1995). There are several variants of the HOV model (see Trefler, 1995; Debaere, 1998 and 2003 and). Distinction can be made between the multi-country version and the country pair version²². For simplicity, let us start with the multi-country version and the country pair approach is then only few steps further²³. The derivation of the multi-country version of the model critically depends on the traditional HO assumptions of (1) identical homothetic preferences, (2) identical constant returns to scale production technology, (3) perfect factor mobility between the sectors within a country, (4) free and frictionless trade with perfect competition, and (5) factor price equalization across the world.

Let $c = 1, \dots, C$ index countries, $f = 1, \dots, F$ index factors and $m = 1, \dots, M$ index sectors.

Let us start with the following simple identity:

$$X_c = Y_c - C_c \quad (3.4)$$

where X , Y and C are respectively $M \times 1$ vectors of net exports, outputs and consumption.

The identity states that country c trades part of its production that is not consumed. With identical homothetic preferences, perfect competition, and free and friction less trade, countries consume a constant fraction, α_c , of world production. That is, $C_c = \alpha_c Y_w$. With F factors and M sectors, there is $F \times M$ technology matrix A whose elements a_{fm} indicate how much of a factor f is needed to produce one unit of output in sector m (i.e. the factor intensity of sector m). The matrix A should be the same for all countries when there is factor price equalization and when all countries have identical constant returns to scale production functions. The factor content of net trade that shows how much capital, labor, etc. are

²² Debaere (1998) also made distinction between the absolute abundance and the relative abundance approaches to the Heckscher-Ohlin-Vanek (HOV) model.

²³ See the derivation of the country pair version of the HOV model in Appendix B.4.

contained in a country's net exports therefore, equals AX_c . It is also apparent that the factor content of production AY_c is equal to the endowment of country c , V_c when assuming factor price equalization, identical technologies and full employment. Pre-multiplying equation (3.4) above by technology matrix A and imposing the above conditions, one can obtain equation (3.5) that relates for each factor separately a country's net factor content of trade to its own and the world's endowments. This will result in the multi-country version of the HOV model.

$$AX_c = V_c - \alpha_c V_w \quad (3.5)$$

where V_c and V_w are respectively country c 's and world endowments of a given factor and other variables are as defined before.

This equation termed as 'HOV equation' by Treffer (1995) states that if country c is abundant in a given factor f ($V_{fc}/V_{fw} > \alpha_{fc}$), then it exports the services of factor f ($AX_{fc} > 0$). In other words, the abundance of a given factor f in country c is said to be revealed in trade for that factor ($AX_{fc} > 0$), when the country consumes less of that factor than it is endowed with ($V_{fc} - \alpha_{fc}V_{fw} > 0$). This simple model puts the previous arguments in a more formal approach. From equation (3.5), the vector of net exports is simply the product of the inverse of the vector of factor intensities across product groups and the excess factor endowments of a country concerned²⁴. By proceeding further the model would give us interesting result. Taking the natural logarithm of both sides of equation (3.5) and re-arranging the equation, the model could be rewritten as follows:

$$\ln X_c = \ln(V_c - \alpha_c V_w) - \ln A \quad (3.6)$$

²⁴ From equation (3.5) taking the technology matrix to the right hand side, we obtain $X_c = (V_c - \alpha_c V_w)A^{-1}$

This result in (3.6) shows that trade patterns are determined by the differences in factor abundance and the difference in the factor intensity of goods as predicted by the HO model. In principle, however, the empirical models of neoclassical trade theory should be estimated with net exports as a dependent variable, and excess factor endowments as the explanatory variables (De Ferranti *et al*, 2002). This is because in HO framework, an identical constant return to scale production technology is assumed (assumption 2 above) and hence difference in production function ceases to be important determinant of production (and hence, export) patterns²⁵. Consequently, net export performance is strictly determined by excess factor supplies of a nation. In developing countries, where import barriers are high and vary from commodity to commodity, inter-country differences in the commodity patterns of imports are greatly influenced by the system of protection applied (Balassa, 1979). Therefore, relative export performance is a preferred indicator of comparative advantage instead of export-import ratios or net exports. A country's relative export performance in individual product category reflects its revealed comparative advantage within a given sector. As a result, following the early works of Balassa (1965, 1977), relative export performance in individual product categories is expressed as the ratio of a country's share in the world exports of a particular product category to its share in the world exports of all commodities. Hence, re-writing the above equation in terms of the Revealed Comparative Advantage (RCA) index,

$$\ln RCA_{cjt} = \ln (V_{cf} - \alpha_c V_{wf}) + \varepsilon_{cjt} \quad (3.7)$$

where ε_{cjt} is the error term in the empirical estimation of the model

The major problem in the empirical estimation of this model is the difficulty in the quantification of the endowment of several factors of production. In this study, three factor supplies; labor, natural resources and capital are considered. Following Balassa (1986) and

²⁵ Furthermore, the HO model assumes away the factor intensity reversals which tend to make this result more power full.

Hall and Jones (1999), physical capital endowments (stocks) are estimated by Perpetual Inventory Method (PIM)²⁶. Following Hall and Jones (1999) in their estimation of capital stocks for a sample of 127 countries, it is assumed that the investment values depreciate at an annual rate of 6 percent to reflect obsolescence of capital. This is also the approach followed by Balassa (1986). Although most studies assume the life length mean of most capital stocks to be above sixteen years (see Hall and Jones, 1999; Zhang *et al*, 2007 and Chowdhury, 2008), this study assume it to be fifteen years. This is because for most African countries data on gross fixed capital investment before 1980 is missing.

The Harbison-Myers index of education is used as a proxy for human capital endowments in several empirical works. This index, derived as the secondary school enrollment rate plus five times the university enrollment rate in the respective age cohorts, is a flow measure. Data on school enrollment for several African countries are not available creating several missing values in the index. Due to this problem in this study the (formal) education expenditure as percentage of Gross National Income (GNI) would be used as a proxy for human capital endowments. Following Romalis (2004), raw material abundance is measured by total land area divided by the total labor force, a simple but imperfect estimate of the abundance of agricultural and mineral resources. Total labor force (above age of 15 years) would also be used as proxy for labor endowment of countries.

In fact, Balassa (1965) noted that the exogenous variables of the model need not take all possible determinants of comparative advantage in to account for such exercise would be a laborious task. This is because there are other likely sources of comparative advantage that do not easily lend themselves to quantification. As a result the model may perform poorly in empirical testing.

²⁶ A full account of how this method works is made in Appendix B.1. For extensive survey see Zhang *et al* (2007) and Chowdhury (2008)

The major innovation here is to analyze the impact of ADs' trade and the Chinese FDI relations on the export structure of African countries. The ADs' impact on the structure of African exports could be direct or indirect. To start with, growth in giant economies such as China and India generates an increase in demand for African exports of the resource goods and results in postponing the production and export of labor intensive manufactured exports. Furthermore, resource boom, due to ADs' increased demand, increase the inter-sectoral competition for labor and the resulting rise in w/r would threaten to limit expansion in manufacturing (Coxhead and Jayasuria, 2008). A resource boom reduces manufacturing sector output through the familiar Dutch disease mechanisms, and this in turn lowers the potential for endogenous manufacturing sector productivity (and export) growth in the future (Goldstein *et al*, 2006).

Impact of ADs on the African export can also be felt through the global market channel. China and India have been the major players in the recent commodity price rise, although the failure of supply to keep pace with demand and depreciation of dollar contributed to the price surge (Streifel, 2008). This could increase the export values of African countries through two ways. First, if the products that China and India demand overlap with the products that African exporters supply, the African countries will benefit from higher prices even if they sell in markets other than China and India. Second, even if ADs' and Africa's export supply have little in common, China's inflationary effects could spill over beyond the products they import directly because of complementarities in production and consumption (Villoria, 2009). However, further increases in primary commodities export may slow continued movement up the scale of capital intensity in production with the corresponding change in pattern of trade. Hence, such complimentarity may have possible danger of locking primary commodity exporters in the production and export of the same in the long run (Alemayehu, 2006).

In general, the expectation is that the rising demand from these countries will increase Africa's potential for primary commodity exports (and hence re-deepen their specialization) both directly, through expanding exports from Africa to China and India, and indirectly, because the price effect from rising Asian demand will increase Africa's earnings from primary exports even if Africa's exporters do not sell to these Asian countries. Therefore, in explaining the change in export structure of African countries and hence the dynamics of their comparative advantage it is important to consider the impacts of the dynamic ADs' commodity imports and FDI flows apart from the standard HO model arguments.

To account for this, the model is augmented by including the commodity imports of China and India. Concerning the imports of ADs, the expectation is that the increased demand of primary commodity is followed by the increased supply of it. The study uses ADs' (China and India's) import of a given commodity group from elsewhere rather than their import from a given African country to reflect the fact that African countries could also benefit from the boom by replacing exports to the third market from countries that have redirected their exports to China and India.

The model is also augmented by including the Chinese FDI. Foreign direct investment in developing countries is biased relatively towards capital-intensive activities. Therefore, it is hypothesized that foreign direct investment will give rise to positive deviations in the net export equations (Balassa, 1986). Nonetheless, it is argued that the Chinese direct investments are resource and market seeking and hence, contributing less to the technological intensity of Africa's export. Consequently, the argument is that such pattern of FDI may rather have the effect of locking African countries in the production and export of the primary commodity sectors. Although the Indian FDI in Africa is also driven by similar motives, it is less significant relative to the FDI flows from China and other traditional sources. Furthermore, Indian FDI in Africa is concentrated in few resource rich countries. Goldstein *et al* (2006) showed that

between 1975 -1990 Africa accounted for only 17 percent of the Indian FDI outflow with a bulk of it going to Senegal and Nigeria. Consequently, the impact Indian FDI is not considered in this study.

Specialization patterns do not alter overnight. The export structure of a given country today matters for what the country will export tomorrow. In the presence of self-reinforcing mechanisms driven by country-specific learning-by-doing, initial conditions dictate the long run trade pattern and growth rate (Brasili *et al*, 1999). Hence, to test for the self re-enforcing effects in the export specialization patterns, the lagged value of the dependent variable would be included in the model as an additional regressor. Given the above arguments, the empirical model to be estimated in this study would be:

$$\ln RCA_{ijt} = \alpha + \gamma \ln RCA_{ij,t-1} + \beta_1 \ln PH_{it} + \beta_2 \ln HM_{it} + \beta_3 \ln RM_{it} + \beta_4 \ln L_{it} + \beta_5 \ln IMPCH_{jt} + \beta_6 \ln IMPIN_{jt} + \beta_7 \ln CHFDIS_t + u_{ijt} \quad (3.8)$$

where Ph_{it} , H_{it} , RM_{it} and L_{it} are, respectively, physical capital, human capital, raw material and labor abundances (the standard HO model arguments); and $IMPCH$, $IMPIN$ and $CHFDIS$ are commodity imports of China, commodity imports of India and the Chinese FDI respectively; ε_{ij} is the error term and i , j and t represent respectively country, sector and time period.

Apart from the need to re-focus the above model to a commodity level to understand the concept of comparative advantage²⁷, there are an added justifications for certain level of disaggregation rather than taking the whole commodities at a time. First, ADs' commodity demand surge is more involved in certain commodities than in the others. Similarly, the

²⁷ Note that comparative advantage is a commodity specific concept

intensity of ADs' impact on global commodity market varies among different commodities. For instance, for the main metals China ranks first and consumes 24 percent of total world production. It is also undergoing a significant change in consumption patterns and increasing the consumption of meats and processed foods (Streifel, 2008). But, in petroleum, China has accounted for less than one-quarter of the growth in oil demand, and has not been the major driving force leading to high oil prices, like it has for metals²⁸. Similarly, China is less-import dependent on agricultural commodities (Streifel, 2008). Second, the disaggregation is important because an analysis based on aggregate relationships covering all commodities could produce misleading results, owing to differences in the degree of sensitivity to different factors (including price and income changes) among types of export commodities (Bond, 1987). In other words, success or lack of success in exporting depends on the type of commodities exported.

This study adopts the World Bank commodity classification which based on Standardized International Trade Classification Revision 4 (SITC rev 4) at two digit level categorizes internationally traded commodities as: (1) Food, (2) Minerals, (3) Agricultural raw materials, (4) Fuels and (5) Manufactures. This level of aggregation is consistent with the objective of the study to identify the change in the export structure of African countries attributable to ADs' increased demand for primary commodities. According to factor proportions, *foods* are mainly resource intensive. *Minerals and fuels* are also raw material and capital intensive. Similarly, *agricultural raw materials* are resource intensive. On the other hand, products in SITC 6 (*basic manufactures*) and 8 (*miscellaneous manufactures*) are mainly labor-intensive, products in SITC 5 (*chemicals*) are mainly technology-intensive and/or capital-intensive, and products in SITC 7 (*machinery and transport equipment*) are mainly capital-intensive and labor-intensive (Yue and Hua, 2008). Consequently, the hypothesis is that, a country with large resource base has the export structure biased towards foods, agricultural raw materials

²⁸ However, ADs import of petroleum from Africa is quite significant for some countries such as Sudan.

and minerals. On the other hand, it is also expected that, countries with large accumulation of capital and relatively developed technology would find their exports biased towards manufactures.

In general, the impact of ADs' trade and FDI relations with Africa should be analyzed in the context of broad trade specialization patterns and industrial development challenges. Hence, the study addresses the issue by showing whether the export specialization patterns are characterized by stickiness in the context of specialization distributions analysis. The factor proportions model is then used to uncover such stickiness. The main task in here is, therefore, to see whether the ADs' trade and Chinese FDI relations are significant in such patterns.

3.3 Data and Data sources

The disaggregated commodity exports of African countries' are used in the current study. Specifically the study uses trade (export) classification as in Standardized International Trade Classification revision four (SITC rev 4) at two digit level. Accordingly, five commodity groups are distinguished. The study uses the WB disaggregated trade data which, based on the fourth revision (rev. 4) of the Standardized International Trade Classification (SITC), categorized internationally traded commodities as (i) *food* (which corresponds to the commodities in SITC sections 0 (food and live animals), 1 (beverages and tobacco), and 4 (animal and vegetable oils and fats) and SITC division 22 (oil seeds, oil nuts, and oil kernels)), (ii) *minerals* (which includes the commodities in SITC divisions 27, 28, and 68 (nonferrous metals)), (iii) *energy (fuels)* (corresponding to SITC section 3 (mineral fuels)), (iv) *agricultural raw materials* (correspond to SITC section 2 (crude materials except fuels) excluding divisions 22, 27 (crude fertilizers and minerals excluding coal, petroleum, and precious stones), and 28 (metalliferous ores and scrap)) and . The commodities in SITC sections 5 (chemicals), 6 (basic manufactures), 7 (machinery and transport equipment), and 8

(miscellaneous manufactured goods), excluding division 68 are classified as (*v*) *manufactures*. Manufactures are also used in this study for the purpose of comparison.

The total merchandise exports of each country and the world merchandise exports are used to calculate the indices of RCA for each country. Labor and physical and human capital endowments are used as the usual arguments of the model. Ratio of land area to labor force is also used as proxy for raw material abundance. The study also uses disaggregated (two digit SITC rev.4) commodity imports (at constant US Dollar) of ADs to augment the model. Chinese FDI flows are also used to capture the impact of foreign capital and know how on the export structure of Africa. The missing values in variables of the model are imputed by multiple imputations mechanism using the *AmeliaView* program²⁹

The study covers the period between 1995 and 2007. Although the ADs' growth surge started in the early 1990s, the absence of data for the year before 1995 for some variables and extensive missing values for several variables ruled out the possibility of extending the study period to before 1995. Since the latest WB and IMF CD ROMS (i.e. 2008/09) provide data on several variables only till 2007, the last period of the study would be 2007. Consistent with the objective of the study, we have five non exclusive sample groups of African countries. The sampling procedure is that, for each commodity group all top ranking trading partners of China and India for which data are available are included in the samples. Hence, we have different sample of countries for each commodity groups although several countries are common for all of the commodity groups³⁰. Although the sample countries for each group are fairly not large in number, they represent more than 50 percent of the export of the region. For

²⁹ *Amelia*, named after a famous missing man called *Amelia*, is a program for missing values. A full account of how it works and the intuition is documented in Appendix B.3.

³⁰ The sample countries for each group of commodities are listed in Appendix A.1.

instance, the sample countries constituted 56 percent of the Africa's export in 1995, 55 percent in 2000 and 59 percent in 2005³¹.

The study uses data collected from several sources. The disaggregated commodity exports of African countries are obtained from the WB African Development Indicators (ADI) CD ROM (2008/9). Similarly, data on export of different sectors at better disaggregation level is obtained from the UNCTAD Handbook of Statistics 2009 online database. Data on human and physical capital are calculated from the WB African Development Indicators (ADI) CD ROM (2008/9). Data on land area are also used from the same source. Labor endowment data are collected from the UNCTAD Handbook of Statistics 2009 online database. On the other hand, the commodity imports of China and India are collected from the WB World Development Indicators (WDI) CD-ROM (2008) and the IMF Direction of Trade Statistics (DOTS). The FDI flows are obtained from UNCTAD's World Investment Statistics (WIS) online database, the FDI STAT

³¹ *The figures are calculated from the World Bank African Development Indicators CD ROMS (2008/9) after adjusting for missing values.*

CHAPTER FOUR

4. Estimation Techniques, Results and Discussions

In the previous chapter an attempt has been made to show the method of analysis that would be adopted in this study. Specifically, in chapter three the study showed how to test the de-specialization and stickiness of the national export patterns. The study also specified the main model in the context of broader theoretical issue. In this chapter, the study implements these techniques empirically. The chapter is, therefore, organized as follows. In section 4.1 the Galtonian Regression method is used to analyze the stability of African export structure. Estimation techniques of the main model would be discussed in section 4.2. In section 4.3 estimation result would be presented. The chapter will wind-up by the discussion of the estimation results.

4.1 Explaining the Stability of African Export Structure: Stickiness or De-specialization?

As pointed out in chapter three, a statistical test of the stability of the national export specialization patterns can be approached in two ways: the country-wise and the sector-wise methodology. The former approach tests whether countries are stable across sectors and whether they tend to become more or less specialized intra-country. On the other hand, the second approach tests whether countries tend to converge in the same sector. However, the two approaches are fairly similar. In testing the stability of African export structure, the Galtonian regression is estimated along both methodologies. In the country-wise approach the regression is estimated country by country for five commodity groups: (1) Foods, (2) Agricultural raw materials, (3) Fuels, (4) Minerals and (5) Manufactures (see Table 4.1). The sector-wise analysis is conducted across eleven sectors (seven primary commodity and

Table 4.1: The Galtonian Regression Result: The Country-wise Approach

| Country | Food | | | Agri. Raw Materials | | | Fuels | | | Minerals | | | Manufactures | | |
|----------------------|---------|------|-------------|---------------------|------|-------------|---------|------|-------------|----------|------|-------------|--------------|------|-------------|
| | β | R | $ \beta/R $ | β | R | $ \beta/R $ | β | R | $ \beta/R $ | β | R | $ \beta/R $ | β | R | $ \beta/R $ |
| <i>Algeria</i> | 0.51 | 0.66 | 0.78 | 0.38 | 0.36 | 1.05 | 0.60 | 0.61 | 0.99 | 0.35 | 0.35 | 1.01 | 0.47 | 0.46 | 1.03 |
| <i>Cape Verde</i> | 0.71 | 0.65 | 1.10 | | | | | | | | | | 1.40 | 0.76 | 1.84 |
| <i>Cote d'Ivoire</i> | 1.09 | 0.82 | 1.33 | 0.26 | 0.30 | 0.87 | 0.68 | 0.54 | 1.26 | | | | 0.47 | 0.61 | 0.77 |
| <i>Egypt</i> | -0.36 | 0.35 | 1.04 | 0.76 | 0.56 | 1.37 | 0.18 | 0.42 | 0.42 | 1.23 | 0.85 | 1.44 | 0.81 | 0.67 | 1.21 |
| <i>Gabon</i> | 0.15 | 0.14 | 1.06 | -0.09 | 0.10 | 0.90 | | | | 0.19 | 0.17 | 1.10 | | | |
| <i>Gambia</i> | 0.57 | 0.66 | 0.86 | -0.09 | 0.10 | 0.90 | | | | | | | 0.15 | 0.14 | 1.06 |
| <i>Madagascar</i> | 0.50 | 0.50 | 1.00 | 0.34 | 0.36 | 0.94 | -0.14 | 0.14 | 1.00 | 0.68 | 0.69 | 0.98 | 0.52 | 0.56 | 0.93 |
| <i>Malawi</i> | 0.71 | 0.73 | 0.97 | 0.13 | 0.14 | 0.92 | 0.15 | 0.14 | 1.06 | 0.29 | 0.28 | 1.03 | 0.78 | 0.79 | 0.99 |
| <i>Mauritius</i> | 0.67 | 0.60 | 1.12 | 0.21 | 0.17 | 1.21 | -0.13 | 0.10 | 1.30 | 0.64 | 0.56 | 1.15 | 0.34 | 0.35 | 0.98 |
| <i>Morocco</i> | 0.31 | 0.32 | 0.98 | -0.01 | 0.10 | 0.05 | 0.28 | 0.26 | 1.06 | 0.89 | 0.79 | 1.13 | 0.71 | 0.76 | 0.93 |
| <i>Mozambique</i> | | | | | | | | | | | | | 0.04 | 0.24 | 0.16 |
| <i>Senegal</i> | 0.55 | 0.52 | 1.06 | 0.31 | 0.30 | 1.03 | -0.11 | 0.10 | 1.10 | 0.43 | 0.47 | 0.92 | | | |
| <i>South Africa</i> | 0.07 | 0.10 | 0.70 | 0.88 | 0.71 | 1.23 | 0.07 | 0.10 | 0.70 | 0.38 | 0.41 | 0.92 | 0.06 | 0.10 | 0.60 |
| <i>Sudan</i> | | | | 0.77 | 0.83 | 0.93 | 0.43 | 0.46 | 0.94 | -0.06 | 0.10 | 0.60 | 0.28 | 0.32 | 0.89 |
| <i>Tunisia</i> | | | | | | | 0.11 | 0.10 | 1.10 | | | | | | |
| <i>Uganda</i> | 0.14 | 0.14 | 0.99 | 0.27 | 0.36 | 0.75 | -0.14 | 0.14 | 0.99 | 0.34 | 0.33 | 1.03 | 0.50 | 0.42 | 1.18 |
| <i>Zambia</i> | 0.51 | 0.69 | 0.74 | 0.51 | 0.78 | 0.65 | 0.44 | 0.55 | 0.80 | 0.54 | 0.52 | 1.04 | 0.46 | 0.42 | 1.08 |

Note:

The Breush-Pagan heteroskedasticity tests fails to reject the null of constant variance in all the regressions

four manufactured export sectors) (see Table 4.2).

Several points emerge from the county-wise analysis (see table 4.1 above). All $\hat{\beta}$ values are significantly different from zero and below unity for most of the countries and in all five commodity groups showing that the hypothesis of reverse or random patterns in export structure can be rejected. This result implies that these countries are specializing in the sectors in which they are relatively less specialized and de-specializing in the sectors where they are already specialized. This result is tantamount to saying that these countries are stepping from exporting primary commodities to, for example, labor intensive manufactured goods export. On the other hand, it also points to the fact that most of the countries in the sample have $\hat{\beta}$ values either significantly less than 0.5 or not significantly different from 0.5 except for food exporting countries implying low stability in export specialization patterns. Most of the food exporting countries display a very stable patterns as their $\hat{\beta}$ values are significantly higher than 0.5. South Africa, Egypt, Morocco, Gabon and Uganda are the exceptions with the $\hat{\beta}$ values either lying below zero or between zero and 0.5. From these entire points one can argue that African countries are characterized by changing export patterns, where the dynamics is away from the traditional commodities. However, the interpretation placed on $\hat{\beta}$ values may not be a necessary condition to have changing export patterns or re-deepening specialization patterns. Hence, as an appropriate gauge of these concepts we need to rely on the distribution analysis of export patterns. In Table 4.1 above $|\beta/R|$ shows the direction of change in the specialization patterns.

In the food exports, the results in Table 4.1 show that in about 50 percent of the countries in the sample, the value $|\beta/R|$ is greater than unity implying a general increase in the dispersion of the specialization patterns and hence, a trend towards increase in specialization (σ -specialization patterns) in the sector. This implies that those countries initially specialized

in this sector tend to be more specialized and vice versa. An even credible pattern is observed in fuel and mineral exporting countries. In fuel exports about 55 percent of the sample countries display the σ -specialization patterns. Furthermore, four countries, Algeria, Madagascar, Sudan and Uganda tend to display relatively unchanging pattern in the sector. Similarly, in the mineral export two-third of the countries in the sample show a general increase in specialization, the exceptions in this case being Madagascar, Senegal, South Africa and Sudan which tend to be less specialized. In agricultural raw material export the result shows the σ -de-specialization patterns for more than 60 percent of the countries. In fact, almost half of the countries in the sample are characterized by near unchanging pattern. This sector is also characterized by β -de-specialization patterns with only three countries registering $\hat{\beta}$ values above 0.5. Algeria, Egypt, Mauritius, Senegal and South Africa are the exceptions with σ -specialization pattern in the sector. Similar specialization pattern is also observed in manufactured export sector with most countries in the sample displaying unchanging or deteriorating specialization pattern in the sector.

The sector-wise analysis also conveys similar result (see Table 4.2 below). The result indicates σ -divergence patterns for all sectors except four: the agricultural raw material export, other ores and mineral export, chemical products and commodities classified under 'other manufactured goods'. This implies that the dispersion of specialization in most of the sectors has increased. Put differently, countries that are specialized in a given sector tend to increase their specialization in the sector and /or countries that are under specialized in a given sector tend to decrease their specialization in the sector. More generally, countries increased their specialization in the sectors where they are initially advantaged and decreased their specialization in the sector where they initially lost the ground. Specifically, basic foods; beverages and tobacco; non ferrous metals; pearls, precious stones and non monetary gold and

Table 4.2: Galtonian Regression Result: The Sector-wise Approach

| Sectors | α | β | R | $ \beta/R $ |
|--|----------|---------|------|-------------|
| Primary commodities | | | | |
| <i>Food, basic</i> | 0.61 | -0.20 | 0.20 | 1.00 |
| <i>Beverages and tobacco</i> | 0.08 | -0.18 | 0.17 | 1.04 |
| <i>Agricultural raw materials</i> | 0.31 | -0.23 | 0.24 | 0.94 |
| <i>Non-ferrous metals</i> | 0.37 | -0.54 | 0.52 | 1.04 |
| <i>Other ores and metals</i> | 0.47 | -0.06 | 0.10 | 0.60 |
| <i>Pearls, precious stones and non-monetary gold</i> | 0.55 | -0.13 | 0.10 | 1.30 |
| <i>Fuels</i> | 0.75 | -0.23 | 0.22 | 1.03 |
| Manufactures | | | | |
| <i>Chemical products</i> | -0.44 | -0.04 | 0.10 | 0.40 |
| <i>Machinery and transport equipment</i> | -1.13 | -0.52 | 0.48 | 1.08 |
| <i>Iron and steel</i> | -0.05 | -0.25 | 0.22 | 1.12 |
| <i>Other manufactured goods</i> | -0.28 | -0.02 | 0.03 | 0.63 |

Notes:

Commodities included in each specific sector according to the Standardized International Trade Classification Revision Four (SITC rev 4) at two digit level are listed in Appendix A.2

The Breush-Pagan heteroskedasticity test fails to reject the null of constant variance in all the regressions

fuels are sectors with σ -divergence patterns in primary commodities export. Similar to the general result from country-wise analysis, agricultural raw material export display the σ -convergence pattern. Dispersion of the specialization has also decreased for commodities (sectors) classified as other ores and minerals. In manufactured goods export, it is only in machinery and transport equipment and iron and steel that specialization has increased and hence sizeable σ -divergence pattern can be observed.

In general, both the country-wise and sector-wise analyses point to similar result: while σ -specialization pattern is evident from the country-wise analysis except in agricultural raw material export, the σ -divergence pattern characterizes all the primary commodity export sectors except agricultural raw material and other ores and minerals exports sectors. This implies that African countries are increasing their specialization in primary commodity export sectors presenting the evidence of re-deepening specialization in these sectors. On the other hand, in manufacturing sectors, similar evidences are not evident except in few countries and few sectors. In sum, the whole result is that African countries export structure is characterized by re-deepening specialization in the traditional export sectors.

4.2 Estimation Techniques: The Main Model

To uncover the possible determinants of export specialization in Africa and sticky specialization attributable to the ADs' trade and the Chinese FDI relations, the augmented multi-country version of the HOV model would be estimated. The analysis is made using panel data. Panel data analysis has several advantages over cross section and time series analyses (Baltagi, 2005). The main advantage of panel data is increased efficiency owing to pooling several time periods of data for each individual (cross section) which provides more degree of freedom. Hence, estimators based on panel data are quite often more accurate than estimators from other sources (Cameron and Trivedi, 2005). Panel data enables one to control

for unobserved individual heterogeneity (the country specific effects) which might be correlated with the regressors. It also provides the possibility of learning more about the dynamics of adjustment (Baltagi, 2005). Furthermore, the presence of panel data reduces identification problems in the presence of endogenous regressors or measurement error and robustness to omitted variables (Verbeek, 2003).

As already noted in the methodology, the lagged value of the dependent variable would be included in the model as an additional regressor. The dynamic panel data model which would be estimated in this study, therefore, has the following specification.

$$y_{it} = \gamma y_{i,t-1} + x'_{it} \beta + \alpha_i + \varepsilon_{it} \quad (4.1)$$

$i=1, \dots, N \quad \text{and} \quad t=1, \dots, T$

where $\alpha_i \sim \text{IID}(0, \sigma_a^2)$ and $\varepsilon_{it} \sim \text{IID}(0, \sigma_\varepsilon^2)$ are independent of each other and among themselves.

The OLS estimation of the above dynamic panel data model leads to inconsistent estimation of β and γ . This is because the regressor $y_{i,t-1}$ is correlated with the individual (country) specific effects, α_i and hence with the composite error term ($\alpha_i + \varepsilon_{it}$) irrespective of the way α_i is treated. In general, in such cases, standard panel estimators are all inconsistent (Cameron and Trivedi, 2005). In the OLS estimation of y_{it} on $y_{i,t-1}$ and x_{it} , the lagged dependent variable $y_{i,t-1}$ is correlated with the individual (country) specific effects, α_i . As a result, the error term violates the assumption necessary for the consistency of OLS. In the within estimation of $y_{it} - y_{i,t-1}$ on $y_{i,t-1} - y_{i,t-2}$ and $x_{it} - x_{i,t-1}$ the error term $\varepsilon_{it} - \varepsilon_{i,t-1}$ is correlated with the lagged dependent variable, $y_{i,t-1} - y_{i,t-2}$ by construction since y_{it} is correlated with ε_{it} from the equation (4.1) above and hence, $y_{i,t-1}$ is correlated with $\varepsilon_{i,t-1}$. Hence, estimation of the within model gives inconsistent parameter estimates. The random

effects estimator is also inconsistent. This is apparent from the fact that the random effects estimator is a linear combination of within and between estimators.

Anderson and Hsiao (1981) proposed the Instrumental Variable Estimator in the first difference model to be consistent. They suggested first differencing the model to get rid of the α_i and then using $\Delta y_{i,t-2} = (y_{i,t-2} - y_{i,t-1})$ or $y_{i,t-2}$ as an instrument for $\Delta y_{i,t-1}$. This IV estimator leads to consistent but not necessarily efficient estimates of the parameters. Consistency of the estimator is guaranteed given the assumption of no serial correlation in ε_{it} . Inefficiency of Anderson and Hsiao (1981) IV estimator arises from the fact that it doesn't make use of all the available orthogonality conditions and it doesn't take in to account the differenced structure on the residual disturbances, $\Delta \varepsilon_{it}$ (Baltagi, 2005).

Arellano and Bond (1991) proposed Generalized Method of Moments (GMM) procedure that exploit all the available moments conditions and hence, more efficient than the Anderson and Hsiao (1981) IV estimation. They argue that additional instruments can be made available by utilizing the orthogonality conditions that exist between the lagged values of y_{it} and the disturbances ε_{it} . The Arellano and Bond (1991) estimator begins by specifying the model as a system of equations, one per period, and allows the instruments applicable to each equation to vary (for instance, in the later period more instruments are available) (Baum, 2006). The instruments include the lags of levels of the endogenous variables (the lagged dependent variable in this case), which enter the equation in differenced form and the strictly exogenous regressor. In general, by period T all lags prior to, say $(T - 2)$ can be considered as instruments. Hence, if T is non-trivial we may need to limit the maximum lags of instruments to prevent the number of instruments from becoming too large i.e. the instrument proliferation. The Arellano-Bond estimator which exploits this advantage is then given by,

$$\hat{\beta}_{ab} = \left[\left(\sum_{i=1}^N \tilde{x}_i' Z_i \right) W_N \left(\sum_{i=1}^N Z_i \tilde{x}_i \right) \right]^{-1} \left(\sum_{i=1}^N \tilde{x}_i' Z_i \right) W_N \left(\sum_{i=1}^N Z_i \tilde{y}_i \right) \quad (4.2)$$

where \tilde{x}_i is $(T-2) \times (K+1)$ matrix with t^{th} row $(\Delta y_{i,t-1}, \Delta x'_{it})$, $t = 3 \dots \dots \dots T$, \tilde{y}_i is a $(T-2) \times 1$ matrix with t^{th} row Δy_{it} , and Z_i is a $(T-2) \times r$ matrix of instruments with elements $Z'_{i3} \dots \dots \dots Z'_{iT}$ on the main diagonal, where $Z'_{it} = [y_{i,t-2} \dots \dots \dots y_{i1}, \Delta x'_{it}]$ and W_N is the weighting matrix.

Arellano and Bover (1995) and Blundell and Bond (1998), nonetheless, showed that lagged levels are often poor instruments for first differenced variables especially if the variables are close to a random walk (γ is high) and if T is small. Hence, they proposed using lagged differences in addition to the lagged levels. Specifically, they suggested using the condition $E(u_{it} \Delta y_{is}) = 0$ for $s < t - 2$ and where $u_{it} = \alpha_i + \varepsilon_{it}$. This last estimator which exploits additional moment conditions is more efficient than the Arellano and Bond (1991) estimator and called the system GMM estimator. This estimator has one-step and two-step variants. Although the two-step system GMM estimator is asymptotically more efficient, the reported two-step standard errors tend to be severely downward biased (Arellano and Bond, 1991). Windmeijer (2005) devised a method of generating standard errors which are corrected for the downward bias of the reported errors. Hence, the precision of the two-step estimator should be evaluated after 'the Windmeijer finite sample correction' procedure.

The consistency of the GMM estimators depends heavily up on the condition $E(\Delta \varepsilon_{it} \Delta \varepsilon_{i,t-2}) = 0$. Hence, Arellano and Bond (1991) developed a test for the autocorrelation in the idiosyncratic errors, which, if present, can render some lags invalid as instruments. They propose a test of the hypothesis that there is no second order serial correlation for the disturbances of the first differenced equations. The Arellano and Bond

(1991) test statistics for the null of no second order autocorrelation in the differenced residuals is given by,

$$(\Delta \hat{\varepsilon}'_{t-2} \Delta \hat{\varepsilon}_*) / (\Delta \hat{\varepsilon}'^{1/2}) \sim \mathcal{N}(0, 1) \quad (4.3)$$

where $\Delta \hat{\varepsilon}_*$ is predicted first differenced error term trimmed to match $\Delta \hat{\varepsilon}$.

This test statistic tests for the absence of the second order autocorrelation in the first differenced residuals which would certainly be the case if the errors in the model in levels are not serially correlated or follow a random walk process. Hence, one can discriminate between the two cases by testing for the absence of first order serial correlation in the differenced residuals by similar procedure.

Apart from the second order serial correlation test, there is a need to test for over identification restriction, i.e. the joint validity of the instruments used. To test for the joint validity of instruments Arellano and Bond (1991) suggested (Hansen) Sargan test statistic which, under the null of over identification, is given by

$$\left(\frac{1}{N} Z' \hat{E} \right)' \text{Var} \left[\frac{1}{N} Z' \hat{E} \right]^{-1} \frac{1}{N} Z' \hat{E} \sim \chi^2_{p-k-1} \quad (4.4)$$

where \hat{E} refers to the residuals from the one (two) step estimates, p refers to the number of columns of Z and K is the number of β coefficients.

The Sargan test is not robust to the heteroskedasticity and autocorrelation. Therefore, in one step robust estimation and all two step estimations the Hansen J statistic should be used. However, the Hansen test has its own pitfall as it can be weakened by instrument proliferation. Sargan (Hansen) statistic can also be used to test the validity of subsets of instruments via 'a difference-in-Sargan' test, also known as a C statistic. If one performs

estimation with and without a subset of suspect instruments, under the null of joint validity of the full instrument set, the difference in the two reported Sargan (Hansen) test statistics is itself asymptotically χ^2 distributed with degrees of freedom equal to the number of suspect instruments. The regression without the suspect instruments is called the unrestricted regression since it imposes fewer moment conditions. The difference-in-Sargan test is of course only feasible if this unrestricted regression has enough instruments to be identified (Roodman, 2006).

In general, in this study taking the dynamic nature of the model in to account, one-step system GMM of Arellano and Bover (1995) and Blundell and Bond (1998) would be used to estimate the model. The efficiency gain with respect to the Arellano and Bond (1991) difference GMM estimator would also be shown. A test of second order serial correlation would be made using the Arellano and Bond (1991) second order autocorrelation test procedure. Sargan (Hansen) test of the Arellano and Bond (1991) is used to test the joint validity of the instruments.

4.3 Estimation Results and Discussions

Due to the inclusion of the lagged dependent variable in the model to show the fact that trade patterns do not change fundamentally even over decades, the model is estimated using the dynamic panel data model. The model is first estimated using the Arellano and Bond (1991) difference GMM (see the result in Appendix - C.I). The estimated result shows that the model crashes in all aspects. The standard arguments of the HO model (the endowment variables) are all insignificant and attain unexpected sign in most of the commodity groups. Furthermore, the Sargan test of over-identifying restriction shows that the null of valid instruments is rejected and hence, the instruments fail to be valid. In fact, the difference GMM uses only lagged levels as instruments which are often poor instruments for first differenced variables. This would particularly be the case if the time dimension of the study is small as in this study. Hence, there is a need to resort to system GMM estimation which uses

additional moment conditions and hence more efficient than the Arellano and Bond (1991) difference GMM.

Following the above line of reasoning the model is re-estimated using the system GMM. The results are presented in table 4.3 below. The model is estimated with constant in three of the five regressions. This is because the system GMM doesn't difference out the constant and if the model calls for constant and efficiency increases with it, one needs to preserve it. Overall, all the variables in the model are jointly significant as shown by the large values of the Wald statistic which enable one to reject the null of not jointly significant variables at 1 percent for all the regressions. The Arellano and Bond (1991) test for the second order autocorrelation shows that the null of no second order autocorrelation in differenced errors is not rejected at one percent for all the regressions. However, the null of no first order autocorrelation is rejected at one percent in one regression (export of fuel). In fact, this result is likely since the estimation is made by using lagged dependent variable as an additional regressor. The Sargan (Hansen) test of over-identification also shows that the null hypothesis of valid instruments is not rejected implying that the instruments, as a group, appear exogenous and hence valid.

The estimation results show that the endowment variables (the standard variables of the HO model) have the expected signs and are significant in most of the regressions. For instance, physical capital have negative sign for food and agricultural raw material exports reflecting the fact that the exports of countries with low levels of physical capital are extremely tilted towards goods that embody physical capital, with the reverse being true for countries with abundant physical capital. It attains positive sign for fuels, minerals and manufactured exports. This is also in line with the theory for these sectors are highly capital intensive. Furthermore, the coefficients are also highly precisely estimated except for minerals and manufactured exports. Hence, it appears that physical capital abundance importantly determines the pattern of specialization. Similarly, human capital endowment enhances the

Table 4.3: Estimation result: One step system GMM

| Dependent Variable: lnRCA | | | | | | | | | | |
|----------------------------------|--------------------|----------------|----------------------------|----------------|--------------------|----------------|--------------------|----------------|---------------------|-----------------|
| Variables | Foods | | Agri. Raw Materials | | Fuels | | Minerals | | Manufactures | |
| | <i>Coefficient</i> | <i>Z-value</i> | <i>Coefficient</i> | <i>Z-value</i> | <i>Coefficient</i> | <i>Z-value</i> | <i>Coefficient</i> | <i>Z-value</i> | <i>Coefficient</i> | <i>Z-values</i> |
| <i>lnRCA(-1)</i> | 0.563* | 2.81 | 0.595* | 3.48 | 0.065 | 0.75 | 0.818* | 18.09 | 0.393* | 2.41 |
| <i>lnPH</i> | -0.487** | -2.12 | -0.202** | -2.28 | 0.648* | 4.18 | 0.004 | 0.09 | 0.026 | 0.14 |
| <i>lnHM</i> | 0.711** | 2.01 | 0.225 | 1.78 | 0.081 | 0.22 | 0.184 | 1.03 | 0.868 | 1.75 |
| <i>lnL</i> | 0.894** | 2.13 | -0.147 | -1.23 | 0.243 | 0.70 | -0.238 | -1.7 | -0.195 | -1.01 |
| <i>lnRM</i> | -0.497 | -1.92 | 0.201* | 2.51 | 0.556** | 2.28 | 0.230** | 2.02 | 0.177** | 2.13 |
| <i>lnIMPCH</i> | 0.373** | 2.15 | -0.107 | -0.52 | 2.989* | 5.04 | 0.839* | 3.15 | -0.761 | -1.32 |
| <i>lnIMPIN</i> | 0.087 | 1.09 | -0.32 | -1.28 | -3.555* | -3.32 | -0.196 | -0.61 | 0.616** | 2.04 |
| <i>lnCHFDIS</i> | -0.224 | -1.55 | 0.448** | 2.32 | -1.366 | -1.80 | -0.29 | -0.42 | 0.328 | 0.54 |
| <i>Constant</i> | -3.936** | -2.32 | | | | | -1.898 | -0.44 | 0.941 | 0.33 |
| <i>Specification Test Stat.</i> | | | | | | | | | | |
| <i>Wald Stat</i> | 310.34(0.00) | | 453.90(0.00) | | 184.06(0.00) | | 484.12(0.00) | | 509.90(0.00) | |
| <i>AB AR(1) Test</i> | Z = -2.33(0.020) | | Z = -2.34 (0.019) | | Z= -6.55(0.000) | | Z= -2.51(0.012) | | Z= -1.97(0.049) | |
| <i>AB AR(2) Test</i> | Z = 0.41(0.680) | | Z = -0.13 (0.900) | | Z= -2.05(0.040) | | Z= 0.12(0.901) | | Z= 0.08(0.933) | |
| <i>AB Sargan(Hansen)</i> | Chi2= 4.43(0.816) | | Chi2= 4.00(0.136) | | Chi2= 89.85(0.020) | | Chi2 =81.65(0.068) | | Chi2 =5.73(1.000) | |

Note:

* and ** show one and five percent level significance respectively

export of all sectors but it is insignificant in most of the regressions. This may be related to the proxy used in this study as the total expenditure on formal education and formal education accounts for only a fraction of human capital development (see Romalis, 2009). Raw material abundance has positive sign and significant in agricultural raw material, fuel and minerals export lending support to the factor proportions theory. However, the coefficients on food and manufactured export bear unexpected sign and are less precisely estimated. The proxy used, total land area per labor force which is simply the estimate of agricultural and mineral resource abundance, ceases to be appropriate for these regressions. Finally, lagged dependent variable carries positive sign and is significant in almost all the regressions showing that a reasonable self-reinforcing effect exists in export specialization patterns.

The estimation result also shows that imports of China attain expected signs and precisely estimated showing that it significantly influence the export structure of African countries. The effect of Chinese commodity demand boom on export structure of Africa varies across commodities. Specifically, the impact of Chinese commodity import on the structure of African export is the largest in fuels and minerals. A percent increase in Chinese import of fuels from everywhere will increase the sample countries' specialization in the sector by 2.9 percent. Similarly, one percent increase in China's import of ores and minerals will enhance the African specialization in the sector by 0.83 percent. Although statistically less precisely estimated (significant at 5 percent), China's impact on the food export sector is also considerable with one percent increase in its imports re-deepening Africa's specialization in the sector by 0.35 percent. On the contrary, the Chinese import of agricultural raw materials is insignificant in determining the African export structure. In fact, China and India are less import dependent on agricultural commodities although India has relatively greater presence being the largest consumer of few commodities such as sugar and tea (FAO, 2007 and Streifel, 2009). Although there is no guarantee that such patterns are due to the ADs' weak demand for this sector, the non-parametric test of the previous section also shows that this

sector is characterized by σ -de-specialization and σ -convergence patterns. On the other hand, the Chinese FDI is either statistically insignificant or the coefficients are not of the expected signs except for the export of the agricultural raw materials where it attains expected signs and is significant. A percent increase in the Chinese FDI outflow will enlarge the Africa's specialization in the agricultural raw material export sector by 0.44 percent. Indian imports are not significant for all commodities except for manufactures and export of fuel where it attains unexpected sign. In fact, in most of the regressions Indian imports attain negative coefficients implying that India imports significant portion of these commodities from countries competing with Africa for the world market share and from the market where African countries couldn't benefit by replacing those countries who had redirected their exports to India³². The results on manufactured exports are more interesting. In the regression while Indian imports attain positive and precise estimate that of China bear negative and insignificant coefficient. This shows that, while Indian imports from Africa enhance the African specialization in the manufactures, China's imports tend to crowd out it. This is in line with the fact that the commodity import structure of China and India from Africa is different with Indian imports more diversified than that of China and also encompass labor intensive commodities (Goldstein *et al*, 2006).

One needs to worry about the robustness of this result. As a robustness check, therefore, we need to perform some sensitivity analysis. The model is, then, re-estimated with a bit of different specification. In particular, instead of China and India's commodity import from elsewhere the model is re-estimated with China and India's commodity import from each African country. The use of commodity imports from each African country rather than commodity imports from elsewhere do alter the statistical significance of the variables of interest in all commodity groups except in minerals export (see the result in Appendix - C.2). The signs are, however, preserved. The change in results is plausible. The insignificance of

³² See Appendix A.3

China and India's commodity import from each country implies that the ADs' direct impact on African export structure is trivial. In other words, the indirect impact of China and India's commodity import (from elsewhere) through the world commodity market (price) is more significant than the impact of ADs' direct import from each African country. In fact, for SSA economies, such as Angola, Sudan and Democratic Republic of Congo, the importance of China as a direct destination of exports grew particularly rapidly (see Kaplinsky *et al*, 2006). China imports significant share of its metals consumption from Africa, and hence, making its import of minerals insensitive to the specifications used. The complementarity effect (the economic significance) of the parameter estimates and hence the impact of China's commodity import on export structure of Africa is now smaller in all commodity groups lending support to the above argument that the direct impact is negligible.

In general, we noted several points from the estimation results. First, while China's growth surge and hence its commodity demand boom is significantly affecting the export structure of African countries, India's import is not yet important in influencing the African export structure. China is, in fact, the largest consumer of major commodities. It is the largest consumer of main metals and the second largest user of energy. India, however, ranks several places lower for metals and energy consumption, and recent growth rates have been more moderate (Streifel, 2008). Second, the intensity of China's impact on the export structure of Africa varies across different commodity groups with the impacts being the largest in fuel and mineral sectors. It is also the first or second largest consumer of a number of agricultural foods being in the midst of a significant shift in its consumption patterns, reducing dependence on the traditional staples of rice and wheat to other products such as meats, fruits and processed food (Streifel, 2008). This is also apparent from our result. On the other hand, it is less import dependent in agricultural raw material which is also implied by the regression result. China, on the other hand, negatively influences the specialization in manufacturing

sector. Third, given the proxy used, Chinese FDI flows are insignificant in determining the export structure of Africa except in the agricultural raw material export sector.

In sum, the analyses in this chapter showed that the sample countries re-deepened their specialization in the export of traditional commodities with only few countries diversifying their exports away from those sectors. To explain such re-deepening specialization patterns the multi-country version of the HOV model is estimated. To account for the self reinforcing effects in trade specialization patterns and the fact that these countries had a very low degree of diversification to start with, we estimated a dynamic panel data model where the lagged dependent variable is included in the regressors. China's import demand surge significantly explains such re-deepened specialization patterns. China's import demand surge retard further processing of and diversification away from these commodities, because such processing would have a large opportunity cost with Chinese import demand in its place. In other words, the Chinese import demand surge disrupts the endeavors by African commodity producers to diversify away from traditional exports. On the other hand, Chinese FDI flows and Indian commodity imports are not important in such patterns.

CHAPTER FIVE

5. Conclusions and Policy Implications

As noted in the previous chapters, the role of industrialization in the process of economic development is substantial. Moreover, one can observe, from international comparative experiences, the fact that there is no clear correlation between development and commodity resources. In particular, deepening the reliance on commodity industries has been argued to be at odds with poverty reduction and economic diversification. It is in the context of these arguments that this study examined the impact of African trade re-orientation towards Asian markets on its export structure. Specifically, the study examined whether the ADs' commodity demand surge and the Chinese FDI flows have significantly led African countries to re-deepen their specialization in the traditional commodity sectors. This section presents summary of important findings of the study and give some conclusions based on those findings. Furthermore, it forwards some policy implications of the study.

5.1 Summary and Conclusions

The study analyzed the impact of the growing ADs' commodity imports and the Chinese FDI flows on the export structure of African countries. As a starting point the study examined whether African export structure is characterized by re-deepening pattern or diversification away from the initially advantaged sectors. To do so the study used non parametric test of the Galtonian regression method. This method would provide one with the idea of export specialization distribution analysis. Moreover, to explain the export specialization pattern, the study used the multi-country version of the HOV model and specified an empirical model where the ADs' commodity imports and the Chinese FDI flows are used to augment the model. In general, the principal findings and conclusions of the study are the following.

First, there is a tendency for African countries to increase their specialization in primary commodity export sectors lending support to the evidence of re-deepening specialization in these sectors. This is apparent from both the sector-wise and the country-wise analysis with only small number of countries and sectors experiencing near unchanging patterns. On the other hand, in manufacturing sectors, similar result is not observed except in few countries and few sectors. In sum, the result is that African countries export structure is characterized by re-deepening specialization in the traditional export sector and there is no the evidence of diversification towards non-traditional exports.

Second, while China's growth surge and hence its commodity demand boom is significantly affecting the export structure of African countries, India's import is not yet important in influencing the African export structure. Specifically, the commodity import growth of China is persuading and hence, locking African commodity producers in the production and export of traditional commodities in the perpetual manner. On the other hand, India's weight in such pattern is minimal. This finding is subject to two facts. First, China is the largest consumer of major commodities. It is the largest consumer of main metals and the second largest user of energy. On the other hand, India, ranks several places lower for metals and energy consumption, and recent growth rates in the metals and energy consumption have been more moderate (Streifel, 2008). Second, the import structure of China and India itself is different to some extent. While China's commodity import structure (from Africa) is consistent with its Ricardian advantage in commodity production, those of India are much more diversified and also encompass labor-intensive products (Goldstein *et al*, 2006). This result is also apparent from the dissimilar impact of China and India on manufactured exports of Africa with India's import complementing it. On the other hand, given the proxy used, the Chinese FDI is not important in re-deepening the export structure of African countries in the traditional commodities.

Third, the indirect impact of China's commodity demand surge on African export structure is more important than the direct impact. Put differently, the bilateral commodity import of China from Africa is less significant relative to the total commodity imports of China and hence its impacts. This shows that the impact of China's commodity demand growth on export structure of Africa is significantly felt through the rising world commodity prices or through the redirection of commodity exports to the third markets by replacing those countries that have redirected their exports to China.

Finally, the intensity of the impacts of China's commodity import surge on the export structure of Africa varies across different commodity groups. The impacts are sizeable in fuel and mineral sectors. China is, in fact, passing through the resource intensive economic growth with industrialization and fixed capital formation taking the lead (Farooki, 2009). These activities generated high demand for industrial metals and minerals. Being in the midst of a significant shift in its consumption patterns, China's impact in the food export sector is also considerable. On the other hand, it is less import dependent in agricultural raw material and hence its impact in this sector is of less significance.

5.2 Policy Implications

Given the result that the Chinese commodity demand surge disrupt the movement away from the commodity exporting and diversification to labor intensive manufactures, African policy makers are faced with challenging and often contradictory policy options. Given China's economic size and its dynamic growth, however, its impacts are non marginal and not limited to countries that trade directly with China. Consequently, optimal policy stances should be developed to maximize the benefits and minimize the challenges of ADs' trade and FDI relations with Africa. In this regard, with the China's integration in to the global economy, the often stated argument that a country should specialize and export a commodity of its

comparative advantage may risk African countries locked in the traditional export sectors in the long run. This calls for innovative policy responses to China and the need to balance between the temporary resource windfall gain and the future industrialization strategies of the continent, if the continent is to follow the path to industrial development in the future. Specifically, there should be carefully tailored indigenous and explicit (and in some cases diverging) policy responses to China and India. In this respect the role of government policies should be crucial. This is because how wisely the revenue from the resource boom is being used has also important implication for the industrial development of the continent, although this does not emerge from our analysis. The management of resource-based revenue is complex and often requires a well-developed governance system and well-considered national development objectives. The quality of government policies and institutions, therefore, might be important determining factors for ensuring market driven industrial development and leading to sustainable development on the proceeds of the resource goods.

As an area for further research, the bilateral commodity trade and the ADs' impact on world commodity prices are not the only channel through which China affects the African commodity producers. Their impact on world interest rates and the exchange rates (Dutch disease mechanisms) are also potential conduits through which China stimulates the commodity production and re-deepening specialization. Furthermore, it is also essential to single-out the impact of ADs on the export structure of Africa showing what would have happened to it had the ADs been not in place (the with and without cases). These investigations, however, require commodity specific approaches and complex analytical tools for simulating the impact of trade policies such as the Global Trade Analysis Project (GTAP) model.

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Appendix-A: The Data

A.1: Sample Countries for Each Commodity Groups

| Food | Agricultural | | | |
|---------------|---------------|---------------|--------------|---------------|
| | Raw Materials | Fuels | Minerals | Manufactures |
| Algeria | Algeria | Algeria | Algeria | Algeria |
| Cape Verde | Cote d'Ivoire | Cote d'Ivoire | Egypt | Cape Verde |
| Cote d'Ivoire | Egypt | Egypt | Gabon | Cote d'Ivoire |
| Gabon | Gabon | Madagascar | Madagascar | Egypt |
| Gambia | Gambia | Malawi | Malawi | Gambia |
| Madagascar | Madagascar | Mauritius | Mauritius | Madagascar |
| Malawi | Malawi | Morocco | Morocco | Malawi |
| Mauritius | Mauritius | Senegal | Senegal | Mauritius |
| Morocco | Morocco | South Africa | South Africa | Morocco |
| Senegal | Senegal | Sudan | Sudan | Mozambique |
| South Africa | South Africa | Tunisia | Uganda | South Africa |
| Tunisia | Sudan | Uganda | Zambia | Sudan |
| Uganda | Uganda | Zambia | | Uganda |
| Zambia | Zambia | | | Zambia |

A.2: Commodities in sectors in sector-wise approach

Commodities included in each specific sector according to the Standardized International Trade Classification are the following.

1. Primary commodities (SITC 0, 1, 2, 3, 4, 68, 667 and 971)

- i. Food, basic (SITC 0, 22 and 4)*
- ii. Beverages and tobacco (SITC 1)*
- iii. Agricultural raw materials (SITC 2 less 22, 27 and 28)*
- iv. Non-ferrous metals (SITC 68)*
- v. Other ores and metals (SITC 27 and 28)*
- vi. Pearls, precious stones and non-monetary gold (SITC 667 and 971)*
- vii. Fuels (SITC 3)*

2. Manufactured goods (SITC 5 to 8 less 667 and 68)

- i. Chemical products (SITC 5)*
- ii. Machinery and transport equipment (SITC 7)*
- iii. Iron and steel (SITC 67)*
- iv. Other manufactured goods (SITC 6 and 8 less 667 and 68)*

A.3: Indian Commodity Imports from the Rest of the World (Percentage of Total)

| Region | Years | | | | | | | | | | | | |
|----------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
| Industrial Countries | 0.48 | 0.49 | 0.51 | 0.51 | 0.45 | 0.41 | 0.35 | 0.38 | 0.38 | 0.36 | 0.33 | 0.32 | 0.33 |
| Developing Countries | 0.45 | 0.51 | 0.49 | 0.48 | 0.55 | 0.36 | 0.43 | 0.33 | 0.35 | 0.37 | 0.36 | 0.41 | 0.41 |
| Africa | 0.05 | 0.07 | 0.07 | 0.08 | 0.12 | 0.06 | 0.06 | 0.05 | 0.04 | 0.03 | 0.03 | 0.02 | 0.02 |
| Asia | 0.14 | 0.15 | 0.16 | 0.18 | 0.19 | 0.17 | 0.22 | 0.19 | 0.21 | 0.21 | 0.22 | 0.26 | 0.28 |
| Europe | 0.04 | 0.04 | 0.03 | 0.02 | 0.02 | 0.02 | 0.03 | 0.02 | 0.02 | 0.02 | 0.03 | 0.03 | 0.03 |
| Middle East | 0.21 | 0.24 | 0.22 | 0.18 | 0.21 | 0.09 | 0.10 | 0.05 | 0.06 | 0.08 | 0.07 | 0.07 | 0.06 |

Source: Calculated from the IMF Direction of Trade Statistics (DOTS)

Appendix-B: Technical Issues

B.1: The Perpetual Inventory Method (PIM)

(based on Zhang et al, 2004 and Chowdhury, 2008)

The perpetual inventory method (PIM) is an economic model that enables stocks to be calculated from the associated investment flows. It does this by accumulating past investments of assets over their estimated service lives to estimate a gross capital stock measure. The main source of input data for the PIM is capital investment data (in constant price terms). Data are also required on the service life of the asset to ensure that the resultant gross capital stock measure does not include the stock of an asset that is no longer of any economic use. In general the parameters that are central to the application of PIM are:

- i.* the asset service life
- ii.* the retirement distribution, and
- iii.* the depreciation function

The first concept refers to the length of time, on average, that an asset is expected to be economically useful as it does not have an infinite life span. The life length of an asset captures how long the investment in a given asset remains in the capital stock measure. The estimates of asset service lives relate to normal wear and tear and planned (or foreseeable) obsolescence. Note also that the life-length mean vary by the type of assets.

The retirement distribution on the other hand shows the probability of the asset being retired around the life-length mean. Assets will not be available for use for exactly life length mean: some assets will not last as long, others will last longer. To account for this, the PIM assumes that there is a retirement distribution around the estimated life-length mean, which can also be

referred to as the discard pattern. There are several different distributions (e.g. normal distribution) that can be modelled within the PIM.

In order to calculate estimates of capital stock, it is also necessary to specify a depreciation function within the PIM. It measures the loss in economic value of an asset as it ages, due to that asset being subject to wear and tear. We have two commonly used depreciation functions that can be applied in a PIM: arithmetic (straight-line method) or geometric (reducing-balance method). While the first one is based on a constant amount of depreciation over that asset's life length, with the market value of the asset falling to zero at the end of the asset's service life, the second is based on a constant annual rate of depreciation over the asset life.

B.2: Changes in Distribution over Time

(based on Hart, 1976)

Hart (1976) showed the changes in a distribution over time in the context of dynamics of inequality (dynamics of earnings). We start by assuming that the joint distribution of earnings at times t and $t - 1$ is bi-variate lognormal. This assumption enables us to use the fact that the bi-variate normal distribution of the logarithms of the earnings can be summarized by $\mu_t, \mu_{t-1}, \sigma_t, \sigma_{t-1}$ and R where R is correlation coefficient between the logarithms of earnings at times t and $t - 1$. The coefficient of the regression of the logarithm of a person's earnings at time t on the corresponding value at time $t - 1$ is denoted by β . If y_{it} denotes the logarithm of the earnings of the i th person at time t , measured in deviations from μ_t , then the assumption of bi-variate normality ensures that the regression on logarithms of earnings is linear and homoscedastic, as in (i) below,

$$y_{it} = \beta y_{i,t-1} + \epsilon_{it} \quad (i)$$

where the stochastic disturbance term, ϵ_{it} independent of y_{it} . Now from (i) we have

$$\sigma_t^2 = \beta^2 \sigma_{t-1}^2 + \sigma_\epsilon^2 \quad (ii)$$

Where $\sigma_t^2, \sigma_{t-1}^2$ and σ_ϵ^2 are, respectively, the variances of earnings at time t , at time $t - 1$ and the disturbance term.

The goodness of the fit measure, the R^2 , can be written as

$$R^2 = 1 - \sigma_{\bar{\epsilon}}^2 / \sigma_t^2 \quad (iii)$$

Now combining (ii) and (iii) we have the following equation which shows the dynamics of the distribution of earnings.

$$\sigma_t^2 / \sigma_{t-1}^2 = \beta^2 / R^2$$

This last equation shows that whether inequality increases depends on the value of $|\beta|$ relative to $|R|$ in the Galtonian regression.

B.3: AmeliaView: A Program for Missing Values: How it Works?

(based on King et al, 2003 and King et al, 2010)

Most statistical analysis methods assume the absence of missing data, and are only able to include observations for which every variable is measured although missing data is a very common problem in social sciences. Amelia II allows users to impute (fill in or rectangularize)

incomplete data sets so that analyses which require complete observations can appropriately use all the information present in a dataset with missingness, and avoid the biases, inefficiencies, and incorrect uncertainty estimates that can result from dropping all partially observed observations from the analysis.

Amelia II performs multiple imputations, a general-purpose approach to data with missing values. The imputation model in Amelia II assumes that the complete data (that is, both observed and unobserved) are multivariate normal. Multiple imputations have been shown to reduce bias and increase efficiency compared to list-wise deletion (deleting all cases with at least one missing cell). Furthermore, ad-hoc methods of imputation, such as mean imputation, can lead to serious biases in variances and covariances. This practice is always inefficient and often biased. Other methods available in commercially available statistical software (such as pair-wise deletion, imputation from regressions, mean substitution are also no better.

Multiple imputation involves imputing m values for each missing cell in your data matrix and creating m completed data sets. (note that across these completed data sets, the observed values are the same, but the missing values are filled in with different imputations that reflect our uncertainty about the missing data.) After imputation *Amelia* will then save the m data sets. One can then apply whatever statistical method would have used if there had been no missing values to each of the m data sets, and use a several procedures to combine the results.

Unless the rate of missingness is exceptionally high, $m = 5$ (the program default) is probably adequate. In order to combine the results, one needs to first decide on the quantity of interest to compute, such as a univariate mean, regression coefficient, predicted probability, or first difference and the multiple imputation estimate of this parameter, $\bar{\vartheta}$, is the average of the m separate estimates, $\vartheta_j (j = 1, \dots, m)$

$$\bar{\vartheta} = \frac{1}{m} \sum_{j=1}^m \vartheta_j$$

Hence, using this procedure and imputing the missing values with $j=1 \dots 5$, the average values for each missing cells were calculated and used for analyses.

B.4: The Country Pair Version of HOV Model

(based on Trefler, 1995 and Debaere, 1998)

The HOV model is a generalization of the HO model and states that a capital abundant country exports capital services (Trefler, 1995). There are several variants of HOV model (see Debaere, 1998, 2003 and Trefler, 1995). Distinction can be made between the multi-country version and the country pair version. The derivation of these models critically depends on the traditional HO assumptions. To derive the country pair version, let us start with a simple identity,

$$X_c = Y_c - C_c \quad (i)$$

where X , Y and C are respectively $M \times 1$ vectors of net exports, outputs and consumption and $c=1, \dots, C$ index countries

This identity states that a country c trades the part of its production that is not consumed. Assume $f=1, \dots, F$ index factors and $m=1, \dots, M$ index sectors. With identical homothetic preferences, perfect competition, and free and friction less trade, countries consume a constant fraction α_c of world production. That is, $C_c = \alpha_c Y_w$. With F factors and M sectors, there is $F \times M$ technology matrix A whose elements a_{fm} indicate how much of a factor f is needed to produce one unit of output in sector m (i.e. the factor intensity of sector m). The matrix A should be the same for all countries when there is factor price equalization and when all countries have identical constant returns to scale production functions. The factor content of net trade therefore, equals AX_c . Similarly, the factor content of production AY_c is equal to the endowment V when assuming factor price equalization, identical technologies and full employment. Pre-multiplying equation (i) above by technology matrix A and imposing the

above conditions, we obtain the equation (ii) that relates for each factor separately a country's net factor content of trade to its own and the world's endowments.

$$F_c = V_c - \alpha_c V_w \quad (ii)$$

Consider equation (ii) for any pair of countries n and s as in the following equations:

$$F_{fn} = V_{fn} - \alpha_{fn} V_{fw}$$

$$F_{fs} = V_{fs} - \alpha_{fs} V_{fw}$$

where f and F represent the factor and factor content of net export of given country and α_{fn} and α_{fs} represent a fractions consumed in country n and s .

By eliminating the world endowment V_{fw} form both equations we obtain country pair version of the HOV model that relates the traded factor services to the factor endowments.

$$F_{fn} - \frac{\alpha_{fn}}{\alpha_{fs}} F_{fs} = V_{fn} - \frac{\alpha_{fn}}{\alpha_{fs}} V_{fs} \quad (iii)$$

The point of the model is clear from this last equation. The country n 's abundance in factor f compared to country s is revealed in trade ($F_{fn} - \alpha_{fn}/\alpha_{fs} F_{fs} > 0$) if n 's endowment of f exceeds that of country s after correcting for consumption shares ($V_{fn} - \alpha_{fn}/\alpha_{fs} V_{fs} > 0$). In other words, this equation implies that if factor f endowment of country n exceeds that of country s , then it should be the case that the factor f content of country n net export exceeds the factor f content of country s net export.

Appendix-C: The Result

C.1: Estimation result: One step difference GMM

| Dependent Variable: lnRCA | | | | | | | | | | |
|---------------------------------|-------------|-------|----------------------------|-------|-------------|-------|-------------|-------|--------------|-------|
| Variables | Foods | | Agricultural Raw Materials | | Fuels | | Minerals | | Manufactures | |
| | β | Z | β | Z | β | Z | β | Z | β | Z |
| <i>lnRCA(-1)</i> | -0.152 | -0.46 | 1.565 | 1.11 | 0.134 | -1.74 | 1.101 | 2.93 | 1.026 | 2.55 |
| <i>lnPH</i> | 0.608 | 0.80 | 1.059 | 0.93 | 6.518 | 4.26 | 2.307 | 2.21 | -0.518 | -0.41 |
| <i>lnHM</i> | 0.014 | 0.06 | 1.246 | 1.81 | 0.278 | 0.24 | -1.521 | -1.51 | -1.877 | -1.19 |
| <i>lnL</i> | 4.463 | 1.65 | 5.416 | 1.27 | 0.134 | 0.70 | 5.338 | 1.15 | 0.35 | 0.7 |
| <i>lnRM</i> | -1.271 | -1.71 | 1.244 | 3.04 | 1.092 | 1.52 | 0.768 | 1.65 | 0.597 | 3.25 |
| <i>lnIMPCH</i> | -0.13 | -0.91 | -0.817 | -1.98 | 1.435 | 1.76 | 1.349 | 2.73 | -1.085 | -1.08 |
| <i>lnIMPIN</i> | 0.013 | 0.11 | -0.092 | -0.23 | -2.212 | 0.02 | -0.790 | -1.47 | 1.109 | 1.37 |
| <i>lnCHFDIS</i> | -0.414 | -1.45 | -0.653 | -0.87 | -1.175 | -0.94 | -1.377 | -1.48 | 1.064 | 1.19 |
| <i>Constant</i> | | | | | | | | | | |
| <i>Specification Test Stat.</i> | | | | | | | | | | |
| <i>Wald Stat</i> | 43.63(0.00) | | 24.77(0.00) | | 57.74(0.00) | | 35.09(0.00) | | 106.35(0.00) | |
| <i>AB AR(1) Test</i> | -0.43(0.66) | | -0.98 (0.32) | | -6.55(0.00) | | -2.51(0.01) | | -1.52(0.12) | |
| <i>AB AR(2) Test</i> | -1.54(0.12) | | 0.98 (0.32) | | 1.59(0.11) | | 0.19(0.84) | | 0.95(0.34) | |
| <i>Sargan(Hansen)</i> | 67.77(0.00) | | 21.12(0.00) | | 96.08(0.00) | | 7.14(0.62) | | 7.39(0.59) | |

C.2: Sensitivity Analysis : One step system GMM

Dependent Variable: lnRCA

| Variables | Foods | | Agricultural Raw Materials | | Fuels | | Minerals | | Manufactures | |
|------------------|----------|-------|----------------------------|-------|----------|-------|----------|-------|--------------|-------|
| | θ | Z | θ | Z | θ | Z | θ | Z | θ | Z |
| <i>lnRCA(-1)</i> | 0.424 | 2.25 | 0.639 | 2.18 | 0.119 | 2.25 | 0.752 | 13.14 | 0.283 | 2.40 |
| <i>lnPH</i> | -1.152 | -2.52 | 0.199 | 0.75 | 0.526 | 0.89 | -0.067 | -0.73 | -0.173 | -0.92 |
| <i>lnHM</i> | 1.819 | 1.98 | 0.205 | 0.43 | 0.545 | 0.66 | 0.193 | 1.48 | 1.113 | 2.33 |
| <i>lnL</i> | 1.621 | 2.15 | -0.648 | -1.89 | -0.153 | -0.18 | -0.236 | -2.22 | -0.849 | -3.57 |
| <i>lnRM</i> | -1.103 | -1.95 | 0.562 | 2.16 | 0.511 | 0.80 | 0.232 | 2.77 | 0.306 | 2.62 |
| <i>lnIMPCH</i> | 0.225 | 1.21 | -0.117 | -0.98 | 0.203 | 1.32 | 0.112 | 2.89 | -0.019 | -0.17 |
| <i>lnIMPIN</i> | 0.045 | 0.21 | -0.203 | -0.52 | -0.154 | -0.33 | -0.014 | -0.36 | 0.443 | 3.60 |
| <i>lnCHFDIS</i> | -0.433 | -0.96 | 0.277 | 1.87 | -1.193 | -1.90 | 0.363 | 2.09 | -0.293 | -0.88 |
| <i>Constant</i> | 2.417 | 0.48 | | | | | -4.109 | -2.33 | 12.470 | 3.00 |

Specification Test Stat.

| | | | | | |
|-----------------------|--------------|--------------|-------------|--------------|--------------|
| <i>Wald Stat</i> | 434.80(0.00) | 390.92(0.00) | 54.26(0.00) | 932.23(0.00) | 448.44(0.00) |
| <i>AB AR(1) Test</i> | -2.03(0.04) | -1.69 (0.09) | -1.47(0.14) | -2.28(0.02) | -1.96(0.05) |
| <i>AB AR(2) Test</i> | 0.48(0.63) | 0.12 (0.90) | 1.02(0.30) | 0.23(0.82) | -1.26(0.20) |
| <i>Sargan(Hansen)</i> | 5.66(0.68) | 4.10(0.12) | 6.47(1.00) | 4.51(1.00) | 4.94(1.00) |

Declaration

I, the undersigned, declare that this thesis is my original work, has not been presented for a degree in any other university and that all sources of materials used for the thesis have been dully acknowledged.

The examiners' comments have been dully incorporated!

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