

**WORKING
PAPER SERIES
CENTRE FOR STRATEGIC
ECONOMIC STUDIES**

CAUSAL LINKS BETWEEN EXPORT, FDI
AND OUTPUT: EVIDENCE FROM
SUB-SAHARAN AFRICAN COUNTRIES

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CSES WORKING PAPER
No. 35

Causal Links between Export, FDI and Output: Evidence from Sub-Saharan African Countries

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1. Introduction

For most African countries, a disappointing history of poor economic performance started in the late 1970s. From the late 1960s to the mid 1970s, the moderate growth of SSA (Sub-Saharan African) economies was mainly inspired by booms in commodity prices, increased foreign aid and a higher growth rate in agricultural output. A combination of factors, including adverse external development, distorted trade policies, serious policy errors and structural and institutional bottlenecks, contributed to deterioration in economic performance in the late 1970s and early 1980s (UNCTAD, 2001).¹ These bottlenecks and poorly designed macroeconomic policies discouraged trade and impeded foreign direct investment (FDI) flows into the region (Rodrik, 1998). The protectionist trade policies and poor governance-conditioned stagnation in turn fuelled a downward spiral. Eventually, the persistent slowdown in economic growth and a failure to achieve significant improvement in the standard of living triggered policy changes in many African countries since the mid 1980s. By the late 1980s, major policy reforms and market-friendly incentives were initiated in many African countries so as to encourage the accumulation of capital and more efficient allocation of resources. As part of the structural adjustment program, financial systems (markets) were restructured in most of the countries, with a major emphasis on trade liberalization and reduction or removal of barriers to trade.² In addition, there has been a significant change in the stance of development policy with import-substitution being replaced by an outward-oriented strategy and export-led growth.

The impacts of these reform measures have so far been limited for the region as a whole (Ahmed, 2005; Nissanke and Aryeetey, 1998) and more efforts towards commitment to reforms in SSA economies is required. The savings rates in these countries remained low and GDP growth rates showed little improvement. There has been even development across countries in terms of trade liberalization and adoption of an export led growth strategy. In order to attain a long-term sustained economic growth, these economic reforms should include policy measures that attract more domestic and international capital.

In this regard two major outward looking strategies are necessary. The first string of strategies is to increase Africa's participation in world markets and enhance its international competitiveness by further advocating international trade, which allows African exporters to capitalize on opportunities in foreign markets (Yeats et al., 1997). Elaborating on this point, Yeats et al. (1997) notes that since the 1950s, trade in SSA countries has grown at relatively low rates so that the region's share of world trade now only stands at about one per cent compared to three in the mid 1950s. This fundamental structural problem of the marginalization of Africa's trade growth is

¹ Economic growth averaged 4.5% in 1965-1969, declining to 4.2% in 1970-1979, before facing serious decline and stagnation to an average of 2.5% in 1980-1989.

² Specifically, these policy reform measures included the abolition of artificial quotas, privatization of state monopolies, and capital market liberalization aimed to reduce trade barriers and encourage inward foreign investment in SSA economies.

largely explained by government-imposed trade barriers that have generally been higher in the continent compared to any other region (Rodrik, 1998). However, in the late 1980s and early 1990s, a number of SSA countries have managed to reverse the economic decline by carrying out more fundamental economic and trade policy reforms.³ Uganda, Ghana and Tanzania are leading examples in this respect while others such as Mali and Gambia have boosted their trade volumes, although are yet to achieve sustained long-term growth (Rodrik, 1998).⁴

The second string of strategies seeks is to increase domestic capital investment and improve productivity by attracting more foreign investment, which will act as a vehicle for international technology transfers and spillovers and for the diffusion of managerial skills and global market access. An increase in foreign capital investment tends to impact positively on export growth and domestic savings (Dupasquier and Osakwe, 2005). UNCTAD (1999a) observes that the rate of return on FDI in Africa has averaged 29 per cent since 1990 and has remarkably improved to above 10 per cent between 1983 and 1997, as a result of foreign investment policy and capital liberalization.⁵

The main objective of this paper is to examine whether FDI and exports have contributed positively to SSA's economic growth. In the paper, an empirical assessment of the relationship between FDI, exports and economic growth in the five SSA countries is conducted against a backdrop of the economic and trade liberation of the last two decades in African countries. Importantly, in this examination of the short-run and long-run causality, we examine the multiplicity of the relationship between income, inward FDI and exports.

This paper also addresses the policy issues surrounding the factors which have been responsible for attracting FDI. While examining the impact of policy reforms in the 1990s, we distinguish between the policies that should have been undertaken, and those that were actually undertaken by most of African countries. We also discuss the policy mix for trade and investment liberalization, such as reduction and removal of tariffs and other barriers to trade and foreign investment, and their relationship with commensurate reforms in fiscal and financial policies, and the sequencing of reforms. Following Sachs and Warner (1997), we divide African economies into three main groups: (a) those countries that have been affected by wars, political instability and major natural and/or man made disasters, such as Sudan, Somalia, Zimbabwe, etc. where frequent cases of policy reversal are likely; (b) those countries that have, to some extent, implemented protectionist policies and hence have higher trade barriers, but a relatively stable political and economic environment such as Burundi, Zaire, Central African Republic, Niger, Serra Leone, etc.; and (c) those countries that have adopted more liberalized trade and foreign investment policies such as Gambia, Ghana, Mauritius, Uganda, Kenya, Nigeria, South Africa, Zambia etc. and qualify as open or classified as reformers by independent observers. While selecting a sample of five countries from this group, in this particular assessment we are interested as to

³ These reforms included, but were not limited to, the removal of export restrictions, lowering of import tariffs, and relaxation of quantitative restrictions on imports.

⁴ In addition to other economic adjustment domestically, two-thirds of SSA countries initiated trade liberalization, average applied tariffs remain high, non-tariff barriers to trade still exist and most of the countries also have a variety of quantitative restrictions and exchange controls (Sachs and Warner, 1997).

⁵ Other studies have also noted that Japanese investments in Africa were more profitable (after tax) in 1995 relative to the early 1990s and were higher compared to many other regions (Bende-Nabende, 2002).

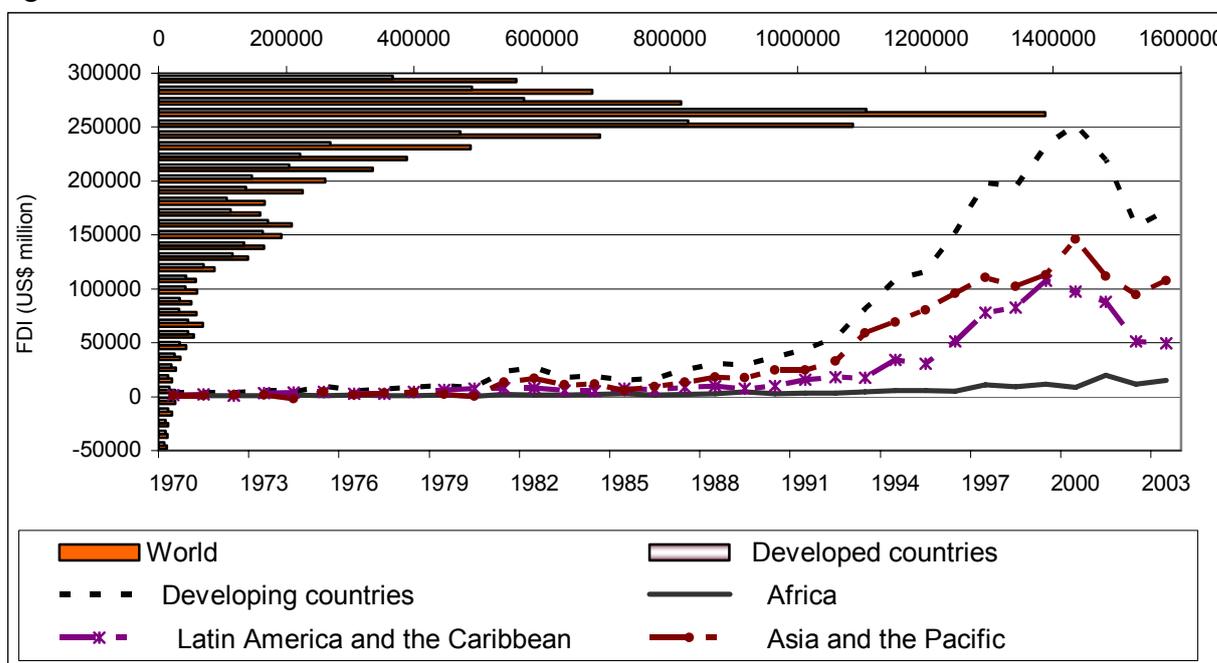
whether export and FDI are pro-growth in group (c) countries and therefore performed better than group (b).

The remainder of this paper is organized as follows. Section 2 provides a historical overview of FDI and trade trends in SSA countries. Section 3 presents the theoretical framework and empirical methodologies, followed by a discussion of the empirical results in Section 4. Summaries, conclusions and policy implications of the study are given in Section 5.

2. FDI Inflows and Trade in Africa

Foreign direct investment (FDI) contributes to economic growth in a number of ways. Generally, FDI can impact on productivity and serve as a catalyst for economic development through productivity enhancement, employment creation (poverty alleviation) and trade growth (Pacheco-López, 2005; OECD, 2002). In addition to this range of prospective benefits suggested by the literature, FDI has two other crucial roles for economic development. First, as FDI inflow brings new capital investment adding to a country's capital stock, it promotes both forward and backward linkages within the domestic economy, thereby stimulating future economic growth.⁶ Second, the greatest contribution of FDI may also come through technology transfer which can stimulate export growth, improve total factor productivity and help a country integrate into global economic networks. It is due to these critical roles played by FDI that SSA and other countries have attempted to design policy measures to facilitate access to and attract new foreign capital.

Figure 1: FDI inflows: Sub-Saharan Africa relative to others

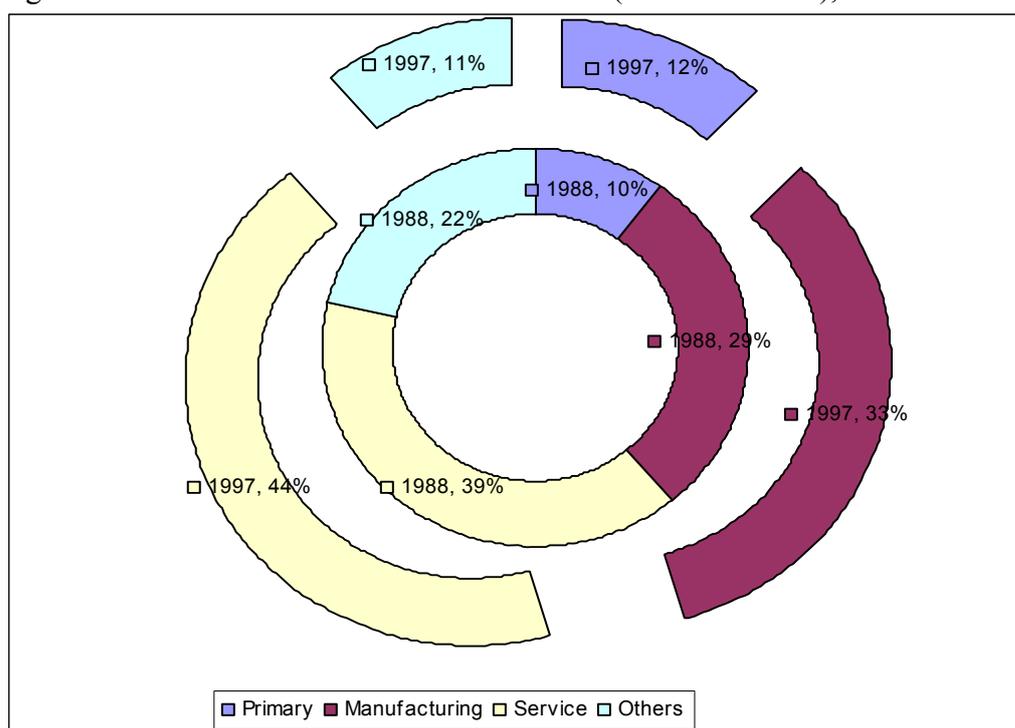


Source: UNCTAD, FDI Database.

⁶ See Ikiara (2003) for a detail discussion on this.

Since the 1970s, Africa's share of the global FDI has plummeted. It fell from 5 per cent in the 1970s to about 1.8 per cent in the 1990s, and further dropped to 0.8 per cent in 1999-2000 (see also Figure 1). Africa's FDI position relative to other developing countries has followed a similar pattern as illustrated in Figure 1. The region's share of total FDI inflow to developing countries dropped from about 20 per cent in 1970s to about 5 per cent in 2002 (Ikiara, 2003), even though inflows into the developing regions increased from about \$20 billion in 1981 to an average figure of \$75 billion between 1991 and 1995 (Figure 1). It is also observed that the share of Africa in FDI flows lagged heavily behind those of Asia and the Pacific, and Latin America and the Caribbean countries.

Figure 2: Sectoral distribution of FDI in Africa (% total inflows), 1988 and 1997



Source: UNCTAD, *Investment Policy Review of Ghana*, 2003.

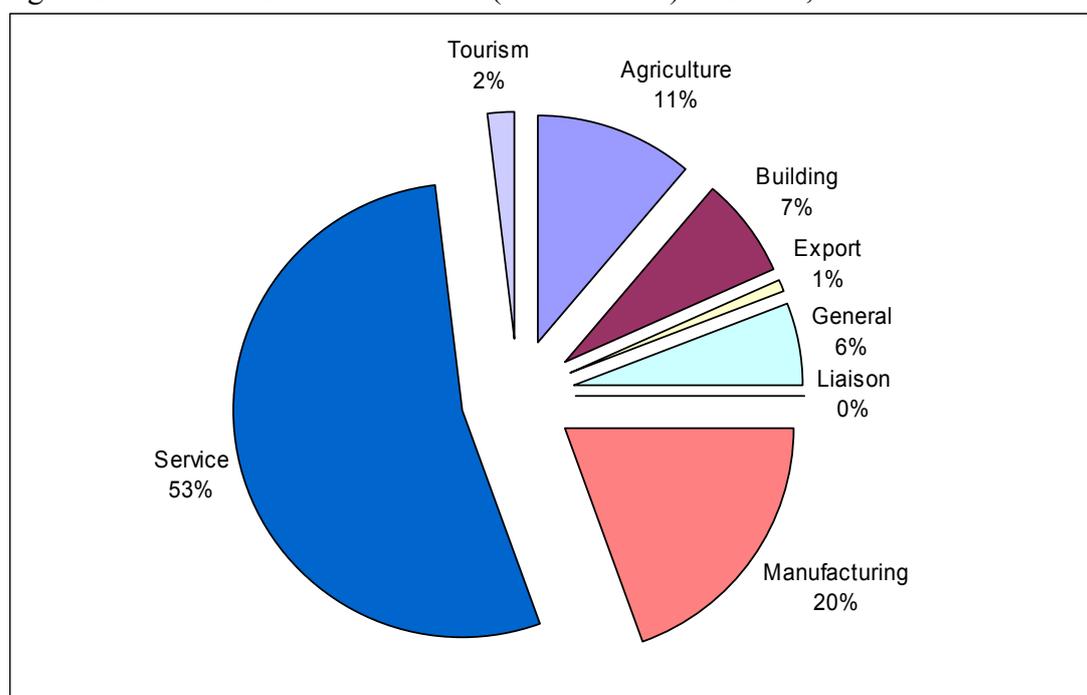
Within the African economies, the destination of FDI inflows has traditionally concentrated in a few resource-rich countries.⁷ However, more recently, a new up-coming group of African economies, such as Tunisia, Tanzania, Uganda and Ghana, have attracted rapidly increasing FDI inflows. Similar to the country distribution, sectorial composition of foreign direct investment in Africa has also traditionally concentrated in a few economic sectors. Reflecting their comparative advantage and factor endowment, primary sectors such as mining and oil accounted for a substantial share of FDI. Figure 2 shows that although the primary sector still remains important, both manufacturing and services are transforming to be key sectors for FDI.⁸ The evidence shows that FDI in Africa is increasingly diversifying, though full data on the sectoral location of FDI in Africa is not readily available. Figure 3 gives a clear picture for the case of Ghana. In the period 1994-2002, for example, 20% of FDI stock in Ghana was in the manufacturing sector, 53% in services, and 12% in

⁷ For details see for example, Bende-Nabende (2002).

⁸ Bende-Nabende (2002) notes that this is the case, even in oil-exporting countries.

agriculture and export trade combined. This shows how Ghana has bridged the savings-investment gap to sustain its industries and maintain economic growth. Considering another case, UNCTAD (1999b) report that there has been improvement in FDI inflows to Nigeria in the most important sectors where manufacturing received 50% and other sectors such primary and services attracted 30% and 20% respectively in 1992.

Figure 3: Sectoral distribution of FDI (% total stock) in Ghana, 1994-2002



Source: UNCTAD, *Investment Policy Review of Ghana*, 2003.

There has been keen competition for FDI among developed and less developed countries. On the assumption that FDI is welcome in most less developed economies/countries (LDCs), a critical issue is how do potential foreign investors decide where to invest their money, an issue important for SSA economies who are trying to attract more foreign investment. From the perspective of a foreign agency, foreign investment represents a more serious and long-term commitment compared with trade. The considerations for foreign investment can be categorized into the following two broad areas: factor endowment of a specific economy and policies for attracting foreign investment. The factor endowment includes domestic market size and potentials, labour quality and costs, natural resources, infrastructure and market access; and the policies include the legal and regulatory environment for foreign investment, fiscal and taxation incentives, accountability and transparency of the governments.

An important question is whether the decline in foreign investment in SSA has been caused by government policies and trade barriers, or by a decline in overall GDP and domestic savings, and/or a lack of investment opportunities. Although the latter is an important contributor, Dean et al. (1994) suggests the former is the main cause since most African countries have made little or only moderate progress towards liberalizing their trade regime. Therefore changes in trade and investment policies may have a powerful impact on foreign capital investment and result in rapid growth.

Table 1: Economic environment, FDI and GDP growth in the five SSA economies (1991-2001)

Items	Ghana (22) ¹	Mali (23) ¹	Nigeria (4) ¹	S. Africa (1) ¹	Zimbabwe (39) ¹
FDI annual growth (1991-2001) ²	14.6	18.3	4.1	35.1	2.8
FDI per capita US\$ (1991-2001) ³	6.1	3.5	11.3	34.8	7.2
GDP annual growth (1991-2001) ²	4.3	4.8	2.8	2.1	0.8
GDP per capita (constant at 2000 prices US\$) (1991-01) ³	233	195	388	2986	620
Total FDI (1991-2001) (million US\$) ³	1235	418	13217	16258	965
Macroeconomic stability	Good	Average	Average	Very good	Poor
Hard and soft infrastructure	Very good	Average	Average	Excellent	Poor
Political risk index in 1995-98 ⁴	3.5	4.2	4.8	2.3	3.3
Corruption index in 1995-98 ⁴	5.4	5.9	7.1	2.5	5.0
Rule of law index in 1995-98 ⁴	5.0	5.0	5.0	4.1	4.1
Inst. inv. risk index in 1995-98 ⁴	7.0	8.3	8.4	5.4	6.8
Cost of regulation in 1995-98 ⁵	14.90%	51.84%	99.30%	36.70%	58.50%

Notes: 1. The numbers in bracket are our country's ranking of the FDI inflows in Africa (2000-2003).

2. Annual compound rate of growth. 3. The data is based on average 1991-2001. 4. The indices rank from 1-10, the risk increases from 1 to 10. 5. Cost of regulation is the cost in % of 1997 GDP.

Sources: Authors' calculations; International Country Risk Guide; Pigato (1999); UNCTAD FDI Database; Djankov et al. (2000); and World Bank, *World Development Report*, various years.

After ranking SSA countries based on FDI attractions, structural reforms and policy implementations, we focus on the business climate and economic details of five economies here. Note that Mali and Zimbabwe are outsiders to our main sample (used in the next section) to facilitate comparisons (replacing Kenya and Zambia). The close relationship between FDI and GDP growth for the five African countries is shown in Table 1. In this table, cost of regulation refers to the economic cost of government over regulation on foreign investment and trade, an important policy indicator which measures the barriers to foreign investment and trade. The economic environment for FDI is represented in the table by hard and soft infrastructure, macroeconomic stability, political risk and corruption indexes, and rule of law and order. Table 1 indicates that there is a positive relationship between FDI and GDP for the five African countries, though in the case of South Africa, the relatively low GDP growth rate relates to the obviously higher base of GDP and international sanctions during the apartheid era. More importantly, the negative correlation between the cost of regulation and FDI growth rate is self-evident, considering the economic environment for trade and investment in the five countries. The higher FDI growth rate in South Africa, Mali and Ghana were related to their relatively lower costs caused by over regulation. The close relationship between government policies, FDI and trade for the five African countries are measured quantitatively in Section 4 of this paper.⁹

An important aspect of market liberalization, which many African countries adopted in the late 1990s, is its ability to promote international trade while attracting foreign capital investment. Sharma (2000) argues that 'the success stories of East and South East Asian countries suggest that FDI is a powerful tool of export promotion', through tapping export opportunities and taking advantage of a country's comparative advantage. Flexner (2000) also suggests that 'discretionary trade or tax regimes may inhibit the ability of FDI to act as a positive means of advancing technology transfer'. Others have argued that trade liberalization benefits FDI as it reduces the cost of

⁹ Detailed policy analyses regarding FDI and trade for these countries are available upon request.

imported inputs thereby enhancing cost-effectiveness of domestic production (Jenkins and Thomas, 2005).

Table 2: FDI inflows as a source of capital

Ghana			Kenya			Nigeria			
Year	FDI	FD I ¹	FD I ²	FDI	FD I ¹	FD I ²	FDI	FD I ¹	FD I ²
1988	5.0	0.9	0.5	0.39	0.0	0.0	378.7	9.2	1.7
1989	15.0	2.2	1.3	62.2	3.9	0.7	1884.3	44.6	7.9
1990	14.8	1.7	1.0	57.1	3.2	0.7	587.9	25.5	2.1
1991	20.0	1.9	1.0	18.8	1.2	0.2	712.4	11.1	2.6
1992	22.5	2.8	1.5	6.0	0.4	0.1	896.6	12.6	2.7
1993	125.0	9.3	5.5	2.0	0.2	0.0	1345.4	18.1	4.2
1994	233.0	19.9	13.5	4.3	0.3	0.1	1959.2	29.8	5.8
1995	106.5	8.2	4.9	33.0	1.7	0.4	1079.3	20.9	3.4
1996	120.0	9.3	5.2	10.5	0.6	0.1	1593.5	26.8	3.4
1997	81.8	5.1	3.2	52.5	2.8	0.5	1539.5	19.3	3.0
1998	55.7	3.3	2.0	11.4	0.9	0.1	1051.3	13.6	3.3
1999	266.7	16.9	10.4	13.8	1.1	0.1	1004.8	12.3	2.9
2000	114.9	10.0	9.6	110.9	16.3	1.1	930.4	12.5	2.2
2001	89.3	6.2	6.2	5.3	0.9	0.0	1104.4	10.1	2.3
2002	58.9	5.1	4.3	27.6	4.5	0.2	1281.1	10.5	2.7
2003	136.6	8.2	5.9	81.7	9.8	0.6	1200.0	9.0	2.1
South Africa			Zambia						
1988	161.4	0.9	0.2	93.3	22.5	2.5			
1989	-206.7	-1.1	-0.2	163.6	37.9	4.1			
1990	-78.4	-0.4	-0.1	202.8	46.0	6.2			
1991	248.1	1.3	0.2	34.3	9.0	1.0			
1992	3.5	0.0	0.0	45.0	13.5	1.4			
1993	10.1	0.1	0.0	52.0	13.8	1.6			
1994	379.8	2.0	0.3	40.0	12.9	1.3			
1995	1241.2	5.8	0.9	97.0	29.7	2.9			
1996	818.1	4.0	0.6	117.1	23.8	3.5			
1997	3817.2	17.9	3.0	207.4	34.8	5.1			
1998	561.1	2.5	0.4	198.0	41.3	6.1			
1999	1502.3	7.3	1.1	162.8	32.5	5.2			
2000	887.9	4.4	0.7	121.7	21.9	3.8			
2001	6788.7	37.9	5.7	71.7	10.5	2.0			
2002	756.7	4.6	0.7	82.0	10.3	2.2			
2003	762.5	2.9	0.5	100.0	9.3	2.3			

Note: FDI is in US\$ million, FDI¹ is a percentage of gross domestic investment and FDI² is a percentage of GDP.

Source: UNCTAD FDI Database and World Bank, *World Development Indicators*, various years.

Despite the decline in FDI share of the continent and the modest ability of the region to attract foreign capital, FDI as a percentage of GDP remained high compared to other developing countries, thanks to a low level of gross capital investment in the region. Foreign capital inflows account for about 10 per cent of SSA's gross fixed capital formation (Ikiara, 2003; see also Table 2). Moreover, the allocation of FDI in the African countries has been biased towards certain economies. For example, FDI as a ratio of gross domestic investment increased from 0.9 per cent in 1988 to almost 17 per cent in 1999 in the case of Ghana and from below 0.1 per cent in 1988 to 16.3 per

cent in 2000 in the case of Kenya (refer to Table 2).¹⁰ FDI inflows accounted for 10.4 per cent and 5.2 per cent of GDP in 1999 in Ghana and Zambia respectively. Overall, all five SSA countries in our sample reveal a pattern of increasing inflows of FDI as a percentage of GDP since the structural reform period of the 1990s. This large proportion of external capital inflows as a share of total investment shows the considerable gap between domestic savings and investment, and the important role FDI attraction can play in promoting economic growth.

Table 3: Trade openness, as percentage of GDP

Country	1980-84	1985-89	1990-94	1995-99	2000-04
Argentina	14	17	16	22	33
Brazil	19	16	18	18	28
<i>Ghana</i>	<i>13</i>	<i>38</i>	<i>50</i>	<i>76</i>	<i>99</i>
<i>Kenya</i>	<i>38</i>	<i>36</i>	<i>44</i>	<i>52</i>	<i>57</i>
<i>Nigeria</i>	<i>39</i>	<i>44</i>	<i>81</i>	<i>79</i>	<i>87</i>
<i>South Africa</i>	<i>54</i>	<i>51</i>	<i>41</i>	<i>48</i>	<i>58</i>
<i>Zambia</i>	<i>78</i>	<i>71</i>	<i>54</i>	<i>63</i>	<i>62</i>
Malaysia	108	116	159	197	216
Thailand	50	59	79	95	127
Highly indebted poor countries	47	41	46	55	59
Middle income countries	42	41	49	52	64

Note: Openness is defined as sum of export and import of goods and services/GDP.

Source: Calculated from data in World Bank, *World Development Indicators*, various years.

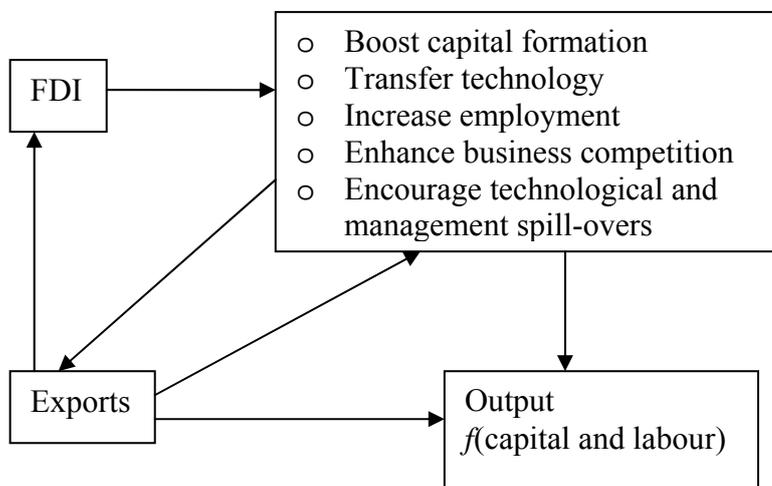
While many studies have highlighted a positive relationship between trade openness and FDI, an outward-oriented trade strategy has been suggested as having a large influence on economic growth (famously known as the export-led growth hypothesis in the literature). Table 3 provides comparison statistics of trade openness in the five selected SSA countries in comparison with average middle income economies and some Asian newly industrialized economies (NIEs). Although it is clear that Malaysia and Thailand are the most open economies, reflecting their export-push development strategies, almost all SSA countries have similar trade ratios to average middle-income economies. Importantly, all the SSA countries in the sample have ratios substantially higher than Argentina and Brazil (see Table 3). In this context, whereas most of the empirical literature treats openness as the principal channel by which liberalization enhances output, an outward orientation in Africa should facilitate a better environment for FDI and enable further integration with the global economy. Thus Yao and Zhang (2003) find that in general more open NIEs have had higher absorption of foreign capital.

From a different point of view, Figure 4 depicts GDP and the export growth relationship among 37 African countries. While the mapping shows some evidence of a positive relationship between GDP and exports, Uganda achieved the highest growth in exports and GDP over the period 1990-2000. Considering this background, we will empirically investigate the links between FDI and trade (exports), and any causal relationship among exports, FDI and economic performance using the five selected SSA countries in the next section.

¹⁰ In support of this, Ikiara (2003) observes that some countries such as Lesotho and Angola recorded inflows/domestic investment of 53.1% and 44.1% respectively in 1996-1998, pointing out that these ratios could be very high in some SSA countries.

mean either multinational foreign investment is expanding the existing export channel in the host country or is channelling FDI linked with new exports (Alguacil et al., 2002; Borensztein et al., 1998; Chen et al., 1995).

Figure 5: Possible links in FDI, exports and income



The relationship between export and economic growth has been a research interest in both the theoretical and empirical literature for some time now. The literature on the export-led growth hypothesis postulates trade as the main engine of growth and therefore claims that outward-oriented policies and exports in particular, improve productivity growth through the following means: (a) enabling the adoption of foreign technologies; (b) resulting greater capital utilization and utilization of advantage of economies of scale and comparative advantage; and (c) helping create a conducive and stable macroeconomic environment through increasing employment, labour productivity and enhancement of the country's external earning power (Edward, 1998; World Bank, 1993; Serletis, 1992; Shan and Sun, 1998; Balassa, 1985).¹¹ Thus the issue of which variable is driving the other and the nature of any link between FDI, exports and economic growth is not clear-cut. Figure 5 illustrates some of the possible transmission mechanisms whereby these three variables influence each other. However, given the criticisms of the export-led growth hypothesis (ELGH) and failure of a number of individual country-specific investigations to exhibit evidence for ELGH in recent studies (see for example Cuadros et al., 2004; Medina-Smith, 2001; Henriques and Sadorsky, 1996; Greenaway and Sapsford, 1994) this examination will focus on the causal relationship between these variables.

Since it is not obvious that any of the links between FDI, exports and growth can be ruled out, our investigation will use a Granger type test of a bi-directional causal link. Further, we will also examine the association and nature of any causal relationship using the Granger Representation Theorem in a multivariate framework and including an error correction term. Examining the causality issue using country-specific case studies has been the topic of many recent studies and the technique of Granger causality, with cointegration and error-correction has been used frequently (Medina-Smith, 2001; Pacheco-López, 2005; Cuadros et al., 2004). Recently, studies

¹¹ In addition to this, other studies have also indicated that there is a bi-directional relation where export enhances growth and output growth promotes further expansion in exports (Ekanayake, 1999; Dutt and Ghosh, 1994).

have resorted to a country case framework due to the fact that widely applied cross-country analysis fails to capture unique country specific information (Zhang, 2001; Catão, 1998; Al-Yousif 1997; Henriques and Sadorsky, 1996; Serletis, 1992). Because of this deficiency, it is now recognized that ‘tests of the export-led model, must intrinsically involve country case studies’ (Medina-Smith, 2001).

For the above reasons, our estimation method will start with a Granger-causality test in a bivariate Vector Auto-regression (VAR) framework. This is mainly for the purpose of exploring two-way causation (interdependency) between variables. In a later stage, the study will then undertake a multivariate temporal Granger causality test adding an error correction term (to capture long-run relationships) upon establishing the existence of cointegration. Let us consider a VAR model where a random variable can be expressed (or explained) as a function of its own past values and past values of other variables in the system. Thus an appropriate formulation will be:

$$\begin{bmatrix} y_t \\ x_t \end{bmatrix} = \beta_0 + \beta_1 \begin{bmatrix} y_{t-1} \\ x_{t-1} \end{bmatrix} + \beta_2 \begin{bmatrix} y_{t-2} \\ x_{t-2} \end{bmatrix} + \dots + \beta_s \begin{bmatrix} y_{t-s} \\ x_{t-s} \end{bmatrix} + \varepsilon_t \quad (1)$$

In the above equation, β_0 and $\beta_{i=1=2\dots=s}$ are a vector of constant terms and matrices of coefficients to be estimated respectively, while ε_t is also a vector of error terms with zero mean. When the series are stationary, the hypothesis of x_t Granger causing y_t can be tested using a standard Wald test. However, if the series are non-stationary, such a causality test will not be valid unless a common trend exists among the variables (Engle and Granger, 1987).

Pasaran and Shin (1995) have developed an alternative approach, the autoregressive distributed lag (ARDL), where causality and long-run relationships can be tested regardless of the order of integration of the variables. Earlier, although ARDL-type models have been applied, the introduction of unit root and cointegration requirements of the time series made their usage suspicious if not inappropriate. Only recently the method has been revived through the work of Pesaran et al. (2001), who demonstrated the possibility of using this approach for the purpose of estimation and identification. Since then a number of studies have recognized and used the ARDL model to test for Granger causality (Pacheco-López, 2005; Zachariadis, 2006). It is now standard practice that once the times series properties of the variables are resolved, a vector error correction system is used where both short-run and long-run dynamics are captured. One specification of this type of formulation is given by:

$$\Delta y_t = \lambda_0 + a_1 \Delta y_{t-1} + a_2 \Delta x_{t-1} + a_3 (y - \gamma x)_{t-1} + v_t \quad (2)$$

Here Δ is the first difference operator, the component in brackets is estimated in the first step and later enters the error correction model, parameter a_3 is the adjustment coefficient of the long-run equilibrium, while the other parameters indicate the short-run adjustments and the error term v_t is $\sim \text{IN}(0, \sigma^2)$. Given this modelling, some studies (Oh and Lee, 2004; Zachariadis, 2006) have pointed out that the Granger-type test of causality can be carried out in three different approaches: (a) through examining the significance of the lagged differences of the variables (joint Wald test); (b) through

investigating long-term causality by checking the significance of the error correction term; and (c) possibly through examining the joint significance of all the lagged variables and of the error term equation above.

However, Pesaran (1997) and Pesaran et al. (2001) emphasize the use of ARDL in analysing the long-run relationship between variables. Thus assuming an appropriate order of ARDL and an error correction model in the spirit of Pesaran et al. (2001), an appropriate equation to test the relationship among variables can be represented in the following form:

$$\Delta y_t = \alpha_0 + \sum_{i=1}^m \beta_i \Delta y_{t-i} + \sum_{i=0}^n \theta_i \Delta x_{t-i} + \phi EC_{t-1} + \xi_t \quad (3)$$

Here m and n represent the number of lags chosen; EC is the error-correction term, β_i and θ_i are expected to capture short-run dynamics, ϕ captures adjustment towards long-run equilibrium, while ξ_t is the random disturbance term. In this case, if θ_i 's are jointly significant using a standard Wald test, then the null hypothesis of 'x does not Granger cause y' is rejected.

4 Empirical Results and Data

The empirical investigations of this study use annual data for the five selected Sub-Saharan African countries from secondary data sources of *International Financial Statistics* (IMF) and *World Development Indicators* (World Bank).¹² The sample countries are Ghana, Kenya, Nigeria, South Africa and Zambia. The variables under study are real export (*Expo*), inward foreign direct investment (*FDI*), real domestic income (y), foreign income (y^{us}), terms of trade (*tot*) and an index capturing openness and regime liberalization (*lib*). The later index is added to examine the role of trade in conditioning regimes policy towards generating a favourable environment for FDI inflow. The *lib* index is constructed from two main reform indicators of domestic and external liberalization which represent a significant move towards a stronger liberal economic environment.¹³ For a sound economic analysis, it is important to convert values from current prices into constant prices. The nominal figures of domestic and foreign GDP, and inward FDI were deflated by the GDP deflator (2000=100).¹⁴ The values of exports of goods and services in current prices were also deflated by the consumer price index based in 2000. Foreign income and terms of trade (ratio of export prices to import prices) are included to capture potential external shocks and the effect of relative prices modification respectively as recommended by the literature (Cuadros et al., 2004; De Gregorio, 1992).¹⁵ With the exception of the index

¹² While some terms of trade indexes reported in various issues initially had a different base year, these were converted into the common base year of 2000. Further, to inspect the consistency of the data for some countries, respective Central Banks were referred to.

¹³ It is also included to capture the deregulation and transformation of the economic systems of these countries. To compute a single index that will be used in the regression analysis, we use the principal weighted average method.

¹⁴ For consistency with the previous literature, US GDP is used as an indicator of foreign income.

¹⁵ We recognize that some studies have used quarterly data in this aspect, however due to unavailability and quality of such quarterly data in developing countries, annual data is preferred, even though having a medium size sample is taken to be an unavoidable shortcoming.

and terms of trade, all of the other series are expressed in log form to compress the measurement scale and reduce estimation problems such as heteroscedasticity.

Before conducting the Granger-type causality test specified under equation (3), we conduct a formal test to confirm the time series properties. We employ the augmented Dickey-Fuller (ADF) unit root procedure to test the level of integration for the variables concerned.

As shown in Table 4, the null hypothesis of the series being non-stationary is not rejected at levels (with the exception of one case, FDI in Kenya) but the same null hypothesis is rejected in favour of the alternative at least at the five per cent significance level when first differences of the variables are taken. These ADF test results indicate that all the variables are integrated of order one for all countries. Having determined the order of integration of the series, we proceed to conduct the multivariate cointegration test applying the Johansen and Juselius (1990) maximum likelihood estimation procedure. As the selection of the correct order of ARDL is important in this type of examination, and given the medium size of our samples, lag order selection by either the Akaike information criteria (AIC), or by the Schwartz bayesian criteria (SC) is recommended (Pesaran, 1997).

Table 4: Unit root test for stationarity

Ghana		T_{μ}	T_{τ}	Differences(1 st)
	<i>FDI</i>	-1.383	-2.022	-4.759
	<i>y</i>	0.139	-2.168	-4.916
	<i>expo</i>	-0.490	-1.409	-6.426
	<i>y^{us}</i>	-0.325	-2.957	-4.518
	<i>tot</i>	-1.784	-0.001	-4.097
	<i>lib</i>	-0.411	-2.172	-5.887
Kenya	<i>FDI</i>	-1.745	-5.885	-4.321
	<i>y</i>	-2.555	-2.730	-5.571
	<i>expo</i>	0.035	-2.792	-4.718
	<i>y^{us}</i>	-0.325	-2.957	-4.518
	<i>tot</i>	-0.300	-3.312	-5.163
	<i>lib</i>	-1.007	-2.464	-5.916
Nigeria	<i>FDI</i>	-1.944	-2.967	-10.374
	<i>y</i>	0.717	-1.665	-3.771
	<i>expo</i>	-1.778	-2.427	-4.148
	<i>y^{us}</i>	-0.325	-2.957	-4.518
	<i>tot</i>	-1.650	-3.393	-5.289
	<i>lib</i>	-0.428	-2.403	-5.887
South Africa	<i>FDI</i>	-2.824	-2.892	-5.903
	<i>y</i>	-0.316	-2.193	-4.091
	<i>expo</i>	-1.130	-3.045	-3.708
	<i>y^{us}</i>	-0.325	-2.957	-4.518
	<i>tot</i>	-1.646	-1.792	-6.372
	<i>lib</i>	-1.881	-1.801	-5.175
Zambia	<i>FDI</i>	-2.739	-3.789	-6.692
	<i>y</i>	-0.247	-1.906	-4.271
	<i>expo</i>	-0.858	-0.359	-7.042
	<i>y^{us}</i>	-0.325	-2.957	-4.518
	<i>tot</i>	-1.307	-2.317	-3.570
	<i>lib</i>	-0.974	-2.401	-5.959
Critical values	1%	-3.639	-4.263	-4.263
	5%	-2.951	-3.553	-3.553

Note: τ_{μ} and τ_{τ} indicate the statistics are under the assumption of a constant and a constant with deterministic time trend respectively. The optimal lag length is selected using Akaike criterion (AIC) and Schwartz criterion (SC).

Table 5: Johansen's Test of cointegration

GHANA Variables list : Expo-y					KENYA Variables list : Expo-y				
Test: Trace					Test: Trace				
(A)	(B)	VAR=1	VAR=3	VAR=4	(A)	(B)	VAR=1	VAR=3	VAR=4
r= 0 ^a	r ≥ 1	13.49	23.13	28.06	r= 0 ^a	r ≥ 1	16.46	25.02	44.91
r ≤ 1 ^b	r ≥ 2	4.55	10.29	8.70	r ≤ 1 ^b	r ≥ 2	4.69	6.53	11.70
Maximum eigenvalue					Maximum eigenvalue				
r= 0 ^a	r ≥ 1	8.95	12.84	19.36	r= 0 ^a	r ≥ 1	11.77	18.48	33.20
r ≤ 1 ^b	r ≥ 2	4.55	10.29	8.70	r ≤ 1 ^b	r ≥ 2	4.69	6.53	11.70
Variables list: Expo-FDI					Variables list: Expo-FDI				
Trace		VAR=1	VAR=3	VAR=4	Trace		VAR=1	VAR=3	VAR=4
r= 0 ^a	r ≥ 1	13.45	22.24	25.62	r= 0 ^a	r ≥ 1	23.07	12.99	7.85
r ≤ 1	r ≥ 2	1.99	3.40	5.54	r ≤ 1	r ≥ 2	4.52	3.17	1.90
Maximum eigenvalue					Maximum eigenvalue				
r= 0 ^a	r ≥ 1	11.46	18.84	20.07	r= 0 ^b	r ≥ 1	18.56	9.81	5.95
r ≤ 1	r ≥ 2	1.99	3.40	5.54	r ≤ 1	r ≥ 2	4.52	3.17	1.90
Variables list: y-FDI					Variable list: y-FDI				
Trace		VAR=1	VAR=3	VAR=4	Trace		VAR=1	VAR=3	VAR=4
r= 0 ^a	r ≥ 1	17.66	23.31	28.92	r= 0 ^a	r ≥ 1	26.27	27.72	34.66
r ≤ 1	r ≥ 2	5.66	3.19	3.34	r ≤ 1 ^b	r ≥ 2	8.31	9.99	6.27
Maximum eigenvalue					Maximum eigenvalue				
r= 0 ^a	r ≥ 1	12.00	20.11	25.58	r= 0 ^a	r ≥ 1	17.96	17.73	28.39
r ≤ 1	r ≥ 2	5.66	3.19	3.34	r ≤ 1 ^b	r ≥ 2	8.31	9.99	6.27

NIGERIA Variables list : Expo-y					SOUTH AFRICA Variables list : Expo-y				
Test: Trace					Test: Trace				
(A)	(B)	VAR=1	VAR=3	VAR=4	(A)	(B)	VAR=1	VAR=3	VAR=4
r= 0	r ≥ 1	17.98	17.99	10.47	r= 0 ^a	r ≥ 1	39.44	17.30	23.33
r ≤ 1	r ≥ 2	7.19	1.97	4.62	r ≤ 1	r ≥ 2	7.35	3.49	2.59
Maximum eigenvalue					Maximum eigenvalue				
r= 0 ^b	r ≥ 1	10.79	16.01	5.86	r= 0 ^a	r ≥ 1	32.10	13.81	20.74
r ≤ 1	r ≥ 2	7.19	1.97	4.62	r ≤ 1	r ≥ 2	7.35	3.49	2.59
Variables list: Expo-FDI					Variables list: Expo-FDI				
Trace		VAR=1	VAR=3	VAR=4	Trace		VAR=1	VAR=3	VAR=4
r= 0 ^a	r ≥ 1	11.24	18.68	30.48	r= 0 ^a	r ≥ 1	13.82	18.97	20.31
r ≤ 1	r ≥ 2	2.32	1.06	1.02	r ≤ 1	r ≥ 2	0.80	1.39	5.81
Maximum eigenvalue					Maximum eigenvalue				
r= 0 ^a	r ≥ 1	8.92	17.62	29.46	r= 0 ^b	r ≥ 1	13.02	17.58	14.51
r ≤ 1	r ≥ 2	2.32	1.06	1.02	r ≤ 1	r ≥ 2	0.80	1.39	5.81
Variables list: y-FDI					Variables list: y-FDI				
Trace		VAR=1	VAR=3	VAR=4	Trace		VAR=1	VAR=3	VAR=4
r= 0	r ≥ 1	14.20	17.15	13.37	r= 0 ^a	r ≥ 1	30.06	34.07	20.30
r ≤ 1	r ≥ 2	1.35	0.60	2.37	r ≤ 1 ^b	r ≥ 2	10.74	5.16	0.81
Maximum eigenvalue					Maximum eigenvalue				
r= 0 ^b	r ≥ 1	12.85	16.55	11.00	r= 0 ^a	r ≥ 1	19.32	28.92	19.49
r ≤ 1	r ≥ 2	1.35	0.60	2.37	r ≤ 1 ^b	r ≥ 2	10.74	5.16	0.81

ZAMBIA Variables list : Expo-y				
Test: Trace				
(A)	(B)	VAR=1	VAR=3	VAR=4
$r=0^a$	$r \geq 1$	11.22	9.38	26.21
$r \leq 1$	$r \geq 2$	3.60	3.26	8.90
Maximum eigenvalue				
$r=0^b$	$r \geq 1$	7.62	6.13	17.31
$r \leq 1$	$r \geq 2$	3.60	3.26	8.90
Variables list: Expo-FDI				
Trace				
(A)	(B)	VAR=1	VAR=3	VAR=4
$r=0^a$	$r \geq 1$	14.46	24.23	26.70
$r \leq 1$	$r \geq 2$	4.45	4.91	6.54
Maximum eigenvalue				
$r=0^a$	$r \geq 1$	10.01	19.32	20.16
$r \leq 1$	$r \geq 2$	4.45	4.91	6.54
Variables list: y-FDI				
Trace				
(A)	(B)	VAR=1	VAR=3	VAR=4
$r=0^a$	$r \geq 1$	14.48	27.32	27.76
$r \leq 1$	$r \geq 2$	6.04	7.73	5.51
Maximum eigenvalue				
$r=0^a$	$r \geq 1$	8.44	19.59	22.25
$r \leq 1$	$r \geq 2$	6.04	7.73	5.51

Note: (A) and (B) indicate the null hypothesis and alternative hypothesis respectively under the test. *a* and *b* indicate significance at 5 percent and 10 percent levels respectively.

The results from the cointegration analysis (see Table 5) show that when three to four lags are used, the null hypothesis of no cointegration ($r = 0$) between variables (*Expo-y*), (*Expo-FDI*) and (*y-FDI*) is rejected at 5 per cent or 10 per cent using either the trace test or maximum eigenvalue test in all the five cases.¹⁶ This provides evidence on the existence of at least one cointegrating vector in the model and therefore we conclude that the variables exhibit a long-run association between them. Having established this, we next estimate an error-correction model based on equation (3) to investigate bi-directional causality between FDI and exports, FDI and income, and exports and income for all five SSA countries.

Table 5: Johansen's Test of cointegration

Table 6 provides the results of the causal relationships between variables.¹⁷ The estimated results show that bi-directional Granger causality exists between FDI and exports in Ghana and Kenya based on the F-statistics for the joint significance of the autoregressive terms, and Nigeria based on the statistical significance of the error correction term.¹⁸ For the other two countries, the Granger causality runs from FDI to exports in South Africa and from exports to FDI in Zambia. This observation supports previous findings by Frimpong and Oteng-Abayie (2006), Hansen and Rand (2005), and Karikari (1992) for the case of African economies and Ram and Zhang (2002),

¹⁶ We have not included the variables terms of trade (*tot*) and foreign income (y^{fs}) as we assume them to be exogenous.

¹⁷ The lags used here were identified using Akaike information criterion (AIC).

¹⁸ To examine the consistency of our findings, we have converted FDI, *y*, and *Expo* variables into per capita and re-conducted unit root and causality tests. The results generally remain the same and are available upon request.

Table 6: Granger causality based on Error-Correction model^a

<i>Ghana</i>	Regression type	Lags taken	Wald test	EC term	Causation
1a	Δ FDI on Δ Expo	(2,2)	10.62**	-0.884*	FDI \leftrightarrow Expo
1b	Δ expo on Δ FDI	(2,2)	11.53**	-0.518	
2a	Δ FDI on Δ y	(2,4)	7.90**	0.213	FDI \leftrightarrow y
2b	Δ y on Δ FDI	(2,2)	12.90**	-0.544*	
3a	Δ Expo on Δ y	(1,3)	22.95**	-0.107**	Expo \leftrightarrow y
3b	Δ y on Δ Expo	(2,3)	7.68*	-0.863*	
<i>Kenya</i>					
<i>Kenya</i>	Regression type	Lags taken	Wald test	EC term	Causation
1a	Δ FDI on Δ Expo	(2,2)	5.28*	-0.241	FDI \leftrightarrow Expo
1b	Δ expo on Δ FDI	(2,1)	5.94**	-1.065**	
2a	Δ FDI on Δ y	(2,4)	8.84**	-0.135	FDI \rightarrow y
2b	Δ y on Δ FDI	(2,2)	1.30	-0.937**	
3a	Δ Expo on Δ y	(3,0)	2.74*	-0.972**	Expo \leftrightarrow y
3b	Δ y on Δ Expo	(2,4)	13.18**	-0.124	
<i>Nigeria</i>					
<i>Nigeria</i>	Regression type	Lags taken	Wald test	EC term	Causation
1a	Δ FDI on Δ Expo	(2,2)	3.39	-0.612**	FDI \leftrightarrow Expo
1b	Δ expo on Δ FDI	(2,2)	1.94	-0.118*	
2a	Δ FDI on Δ y	(1,2)	1.61	-0.676	FDI \leftrightarrow y
2b	Δ y on Δ FDI	(2,1)	2.41	-0.432*	
3a	Δ Expo on Δ y	(3,0)	17.55**	-0.474*	Expo \leftrightarrow y
3b	Δ y on Δ Expo	(1,2)	25.32**	-0.947**	
<i>South Africa</i>					
<i>South Africa</i>	Regression type	Lags taken	Wald test	EC term	Causation
1a	Δ FDI on Δ Expo	(2,1)	6.41*	-0.045	FDI \rightarrow Expo
1b	Δ expo on Δ FDI	(1,2)	1.71	-0.768**	
2a	Δ FDI on Δ y	(2,2)	14.34**	-0.050**	FDI \rightarrow y
2b	Δ y on Δ FDI	(2,2)	1.97	-1.320**	
3a	Δ Expo on Δ y	(2,3)	1.94	-0.102**	Expo \leftrightarrow y
3b	Δ y on Δ Expo	(2,2)	7.31*	1.071*	
<i>Zambia</i>					
<i>Zambia</i>	Regression type	Lags taken	Wald test	EC term	Causation
1a	Δ FDI on Δ Expo	(2,2)	2.82	-0.881	FDI \leftrightarrow Expo
1b	Δ expo on Δ FDI	(2,2)	2.21	0.618**	
2a	Δ FDI on Δ y	(1,4)	8.01*	0.991	FDI \rightarrow y
2b	Δ y on Δ FDI	(2,2)	1.76	-0.830**	
3a	Δ Expo on Δ y	(2,2)	5.23**	-0.050**	Expo \leftrightarrow y
3b	Δ y on Δ Expo	(2,2)	12.05**	-0.246	

Note: ^a Liberalization index was included in all the ARDL models. ** and * denote the statistical significance at the 5 and 10 per cent levels respectively. Arrows \leftrightarrow and \leftrightarrow indicate causality based on standard Wald F-test (joint significance of restriction) and long term causality through significance of error term.

Alguacil et al. (2002), Blomstrom et al. (1992) and De Gregorio (1992) for the case of other economies. Similarly, the null hypothesis 'FDI does not Granger cause growth' is rejected in all countries except Nigeria, where the feedback effect runs from income to FDI. Overall, the test results suggest a causal linkage from FDI to growth (income).

Finally, the statistical significance of F-statistics for the joint significance of autoregressive terms and/or the error term implies a strong bi-directional causality between export and GDP growth in all five Sub-Saharan African countries. These observed results are consistent with previous evidence of a bi-directional causality relationship between exports and growth in a two-variable framework and a dataset from African countries (Ahmad and Kwan, 1991; Bahmani-Oskoe, 1991; Lussier, 1993; Fosu, 1990).

Although we have adopted bivariate VAR in the above analysis, multivariate causality is preferred and at times is more reliable (Lutkepol, 1982). Importantly, one serious drawback of a bivariate causality framework is that it could be biased as it omits other relevant variables. Moreover relationships could be more complex than a two-way causation where consideration of other variables could amplify realized effects. While separating long-term relationship and short-term forecast and taking into account the aforementioned issues, we specify a VAR model to examine a Granger type test of causality with an error correction representation:¹⁹

$$\begin{aligned} \Delta Expo_t = & A_{10} + \sum_{i=1}^{m-1} \Delta \beta_{11} Expo_{t-i} + \sum_{i=0}^m \beta_{12} \Delta y_{t-i} + \sum_{i=0}^m \beta_{13} \Delta fdi_{t-i} + \sum_{i=0}^m \beta_{14} \Delta tot_{t-i} \\ & + \sum_{i=0}^m \beta_{15} \Delta y_{t-i}^{us} + \mu_1 lib_t + a \rho_{t-1} + e_t \end{aligned} \quad (4)$$

$$\begin{aligned} \Delta y_t = & B_{20} + \sum_{i=1}^{m-1} \Delta \beta_{21} y_{t-i} + \sum_{i=0}^m \beta_{22} \Delta Expo_{t-i} + \sum_{i=0}^m \beta_{23} \Delta fdi_{t-i} + \sum_{i=0}^m \beta_{24} \Delta tot_{t-i} \\ & + \sum_{i=0}^m \beta_{25} \Delta y_{t-i}^{us} + \mu_2 lib_t + b \pi_{t-1} + \zeta_t \end{aligned} \quad (5)$$

$$\begin{aligned} \Delta fdi_t = & C_{30} + \sum_{i=1}^{m-1} \beta_{31} \Delta fdi_{t-i} + \sum_{i=0}^m \beta_{32} \Delta Expo_{t-i} + \sum_{i=0}^m \beta_{33} \Delta y_{t-i} + \sum_{i=0}^m \beta_{34} \Delta tot_{t-i} \\ & + \sum_{i=0}^m \beta_{35} \Delta y_{t-i}^{us} + \mu_3 lib_t + c \delta_{t-1} + \xi_t \end{aligned} \quad (6)$$

The results of the temporal Granger causality test for each equation (equations (4) to (6)) are reported in Table 7. As we have indicated previously, the findings in Table 7 provide evidence on the causal relationship between FDI, exports and income. While the Wald test of joint significance of lags is significant in various equations, significance of either joint autoregressive restriction terms or lagged error correction (*t-test*) will imply Granger causality (Cuadros et al., 2004). The statistical significance of the error correction terms in the exports, FDI and income equations (with the exception of a few cases in the income) represent a long-run impact of variables over the others. Furthermore, a positive causal relation from exports and FDI to income is observed for all five SSA countries as indicated by the estimated cointegrating vectors (only in the case of Kenya do we observe a negative impact of FDI). Overall, the results presented provide evidence of existence of a positive causal link and of a long-run impact of exports and FDI on income.

¹⁹ Although not reported due to space constraint, a test of cointegration between variables has been carried out.

Table 7: Multivariate Granger-causality tests on Error-correction model

Ghana						
Regression	$\Delta Expo$	ΔFDI	Δy	Δy^{us}	ΔTOT	Error term
	$\chi^2 (2)$	$\chi^2 (2)$	$\chi^2 (2)$	$\chi^2 (2)$	$\chi^2 (2)$	
$\Delta Expo$	na	13.09**	5.88**	9.31**	7.51**	-0.806**
ΔFDI	3.78	na	2.51	1.37	8.74**	-0.767**
Δy	4.90**	1.72	n.a	1.18	7.11**	-0.701**
$y = 0.078Expo + 0.033FDI - 0.001TOT + 1.304 y^{us} + 0.021lib - 9.003$						
Kenya						
Regression	$\Delta Expo$	ΔFDI	Δy	Δy^{us}	ΔTOT	Error term
	$\chi^2 (2)$	$\chi^2 (2)$	$\chi^2 (2)$	$\chi^2 (2)$	$\chi^2 (2)$	
$\Delta Expo$	na	1.85	3.87	1.97	6.06**	-0.317*
ΔFDI	4.90**	na	4.58*	1.77	4.66*	-1.486**
Δy	1.75	3.13	na	3.82	1.05	-0.835
$y = 0.069Expo - 0.019FDI + 0.001TOT + 1.443 y^{us} - 0.097lib - 20.947$						
Nigeria						
Regression	$\Delta Expo$	ΔFDI	Δy	Δy^{us}	ΔTOT	Error term
	$\chi^2 (4)$	$\chi^2 (4)$	$\chi^2 (4)$	$\chi^2 (4)$	$\chi^2 (4)$	
$\Delta Expo$	na	5.10**	10.74**	19.02**	1.96	-0.781**
ΔFDI	1.88	na	2.03	1.29	4.64**	-0.636**
Δy	6.12**	4.68*	na	4.57*	0.92	0.119
$y = 0.365Expo + 0.028FDI + 0.001TOT + 0.493 y^{us} + 0.021lib + 0.411$						
South Africa						
Regression	$\Delta Expo$	ΔFDI	Δy	Δy^{us}	ΔTOT	Error term
	$\chi^2 (4)$	$\chi^2 (2)$	$\chi^2 (4)$	$\chi^2 (1)$	$\chi^2 (4)$	
$\Delta Expo$	na	2.52	1.09	2.54	2.21	-0.596**
ΔFDI	0.93	na	0.99	2.83	1.79	-1.213**
Δy	5.38*	5.05**	na	3.32*	1.34	-0.168
$y = 0.153Expo + 0.006FDI - 0.002TOT + 0.829 y^{us} - 0.027lib - 2.849$						
Zambia						
Regression	$\Delta Expo$	ΔFDI	Δy	Δy^{us}	ΔTOT	Error term
	$\chi^2 (4)$	$\chi^2 (4)$	$\chi^2 (4)$	$\chi^2 (4)$	$\chi^2 (1)$	
$\Delta Expo$	na	1.91	8.24**	1.37	1.15	-0.964*
ΔFDI	2.04	na	1.20	2.94	1.88	-0.891**
Δy	6.68**	5.76*	na	1.02	1.01	0.379*
$y = 0.203Expo + 0.004FDI + 0.001TOT + 0.485 y^{us} - 0.051lib - 3.263$						

Note: ** and * denote the statistical significance at the 5 and 10 percent levels respectively. na means not applicable and in the parenthesis are degrees of freedom.

Analysis so far has focused on individual SSA nations. Next, we seek to exploit the benefits of panel data estimation, given the finite-sample nature of our time-series. We adopt the Pedroni (1999) estimation approach to test for cointegration which also allows for heterogeneity across individual countries in the mean and time effects. Pedroni (1999) distinguishes between ‘within-dimension’ or ‘panel’ statistics and ‘between-dimension’ or ‘group’ statistics. The former are estimators that pool the autoregressive coefficient in the unit-root tests across different countries separately while the latter set of estimators average the individually estimated coefficients for each country. The ‘group’ estimators allow for additional heterogeneity that makes

them more robust than the ‘panel’ estimators in small samples in the sense that they are less susceptible to size distortions. The panel set comprises of v (a type of non-parametric variance ratio), ρ (the panel equivalent to the Phillips-Perron ρ -statistic), pp (equivalent to the Phillips-Perron t -statistic), and adf which is analogous to the augmented Dickey-Fuller t -statistic. The three ‘group’ statistics are ρ , pp , and adf .

More formerly, Pedroni allows for the long-run relation of the type

$$EC_{i,t} = Y_{i,t} - (\alpha_i + \delta_i t + X_{i,t}) \quad (7)$$

where Y is the dependent variable and X is a vector of regressors. It follows from the above that ‘fdi’, ‘Expo’ and ‘y’ all should be considered as dependent variables in Y . The vector of explanatory variables, X , includes ‘tot’, ‘y^{us}’, and ‘lib’.

For panel estimation, however, we work with per capita figures prior to taking logs, with the exception of ‘tot’, ‘y^{us}’ and ‘lib’. The cointegration results appear in table 8.²⁰ Most of the test statistics and especially the group statistics reject the null hypothesis of no-cointegration. The rejection is particularly strong for the pp and adf tests, as well as the ‘group’ statistics.

Table 8: Pedroni Panel Cointegration tests with heterogeneous trends

<i>(a) Export equation</i>		<i>(b) Income equation</i>	
Panel v -statistics	0.35692	Panel v -statistics	-1.35592
Panel ρ -statistics	-0.09489	Panel ρ -statistics	0.14119
Panel PP -statistics	-2.73928**	Panel PP -statistics	-5.54893**
Panel ADF -statistics	-1.9498*	Panel ADF -statistics	-3.13033**
Group ρ -statistics	0.64446	Group ρ -statistics	0.56818
Group PP -statistics	-2.86847**	Group PP -statistics	-6.72251**
Group ADF -statistics	-1.35966	Group ADF -statistics	-2.69061**
<i>(c) FDI equation</i>			
Panel v -statistics	-0.85674		
Panel ρ -statistics	-1.79031*		
Panel PP -statistics	-6.79585**		
Panel ADF -statistics	-6.08685**		
Group ρ -statistics	-0.58495		
Group PP -statistics	-8.34856**		
Group ADF -statistics	-5.84704**		

Note: Results with Heterogeneous time effects. All tests reported here are distributed as $N(0,1)$. * and ** denote significance at the 10% and 5% levels, respectively.

²⁰ Prior to the cointegration examination, we also perform panel unit root to test the presence or absence of a unit root. With the exception of few cases where we observe FDI to show stationarity and given various weaknesses of panel unit root technique (Karlsson and Lothgren, 2000), the null hypothesis of non-stationarity cannot be rejected.

Table 9: Panel Group FMOLS Results

<i>(a) Export equation</i>			<i>(b) Income equation</i>		
Variable	Coefficient	t-statistic	Variable	Coefficient	t-statistic
FDI	0.011	2.261**	FDI	0.005	0.627
y	1.481	12.846**	Expo	0.271	13.915**
y ^{us}	-0.128	1.180	y ^{us}	0.099	2.882**
tot	-0.001	-2.461**	tot	0.001	3.157**
lib	0.071	3.513**	lib	-0.026	-4.428**

(c) FDI equation

Variable	Coefficient	t-statistic
Expo	2.508	2.343**
y	1.862	1.145
y ^{us}	-1.213	-1.209
tot	-0.001	-0.918
lib	0.529	2.284**

Note: Estimation with common time dummies included. * and ** denote significance at the 10% and 5% levels respectively.

Finally, we also employ Pedroni's (1999) FMOLS estimation procedure to obtain estimates of the cointegrating vector in the three long-run equations. Table 9 presents the results. The evidence here indicates that FDI, local GDP and liberalization all have a positive and statistically significant impact on exports. Also, exports, income in the USA and the terms of trade have a positive and significant effect on domestic income. Further, we find that FDI increases with exports and liberalization reforms. On the other hand, the terms of trade discourages exports and, more surprising, liberalization has adversely affects local income. Consistent with the evidence presented earlier, FDI does not appear to directly impact on domestic income, rather the effect is indirect via its impact on exports.

5. Conclusions and Policy Implications

This is a timely study, given the relatively poor performance of the African countries in attracting FDI and the recent changes in their investment and trade policies.

However, FDI trends observed indicate that the region's share of global FDI inflows has not significantly improved, though the position of Africa's share seems to have improved in recent years. On the other hand, looking at the sectoral composition, FDI is no longer concentrated in a few economic sectors but is diversifying into important sectors such as manufacturing, exports and services.

With many countries implementing steps to liberalize business, economic and market environments to reduce barriers to foreign entry, the amount of foreign capital they attract should increase. Moreover, FDI inflows and its related spillovers should contribute to total factor productivity and hence contribute to economic growth.

This study investigates the short-run and long-run causality relationships between export and FDI, FDI and growth and between export and growth in Sub-Saharan Africa, using the new autoregressive distributed lag (ARDL) approach in the examination of a Granger type test of causality with an error correction. Moreover, the finding is further examined through Pedroni estimation procedure which also allows for heterogeneity across individual countries in the mean and time effects. The

estimation results show that bi-directional Granger causality exists between FDI and exports in Ghana, Kenya and Nigeria. For the other two countries, the Granger causality runs from FDI to exports in South Africa and from exports to FDI in Zambia. Moreover, the estimation results suggest a causal linkage from FDI to growth (income), a positive causal relation from exports and FDI to income is observed for all five African countries studied, as indicated by the estimated cointegrating vectors (only in the case of Kenya do we observe a negative impact of FDI). Finally, the statistical significance of F-statistics for joint significance of autoregressive terms and/or the error term implies a strong bi-directional causality between export and GDP growth in all five Sub-Saharan African countries. Overall, the results presented provide evidence of the existence of a positive causal link and of a long-run impact of exports and FDI on income.

While our findings support the export-led growth hypothesis for these SSA countries, the observed causal positive links between FDI-exports and FDI-income suggest that FDI has contributed to a higher rate of economic growth directly and indirectly (through its effects on exports). Furthermore, given the limited data available, the recent policy reforms and trade and investment liberalization in some African countries may have helped to create a more open trade environment and hence generate positive net FDI benefits. Our findings support the view that FDI influences growth thorough technology transfer (diffusion), thereby speeding up development of new intermediate product varieties (to enhance the export base) and raising general productivity.

Consequently and based on this evidence, African countries should not only promote FDI from overseas but also create a conducive environment and adopt more liberal policy frameworks to attract new FDI and maximize net benefits. To overcome the challenge of ‘partial reform syndrome’, it is recommended that African countries carefully design and implement their reforms and take a more pragmatic and gradual approach in the process of integrating with the global economy, promoting exports and attracting FDI.

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