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Globalisation outcomes and the real output in the sub-Saharan Africa LICs: a cointegration analysis

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ABSTRACT

This article examines the effects of trade openness, foreign direct investment (FDI), and product diversification of exports to the real gross domestic product (GDP) per capita in 11 sub-Saharan Africa Low Income Countries (LIC): Benin, Burkina Faso, the Democratic Republic of Congo, Kenya, Liberia, Madagascar, Malawi, Niger, Rwanda, Sierra Leone and Zimbabwe over the period 1970–2010. We consider time series analysis, including structural break(s) and cointegration modelling. The results indicate that long-run relationships only exist in Kenya, Liberia, Malawi and Sierra Leone. We also document that (1) FDI spurs the real GDP per capita in Kenya; (2) trade openness positively contributes to the real output in Liberia; (3) trade openness is negatively associated with the real GDP per capita in Malawi in the short-run; and (4) product diversification of exports promotes the real GDP per capita in Sierra Leone.

1. Introduction

Recent and ongoing globalisation significantly affects various parameters in both developing and developed countries, particularly after the early 1990s. In the least developed countries (LDCs), there is still discussion whether trade with the rest of the world is harmful to industry; and therefore import restrictions, such as taxes, tariffs and hidden-barriers, are adopted. However, probably due to the revolutionary development in communication and information technologies as well as financial globalisation during the last two decades, international trade has become popular in the LDCs, and trade liberalisation is one of the key development strategies of prominent institutions, such as the World Bank and the United Nations (UN). The process of globalisation has various consequences on economic and financial variables, such as trade openness, diversification of exports, and foreign direct investments (FDI), and all these variables can significantly affect the level of real output, particularly in poor economies. Therefore, this article aims to examine the effects of trade openness, FDI, and product diversification of exports on the real output in Benin,

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Burkina Faso, the Democratic Republic of Congo, Kenya, Liberia, Madagascar, Malawi, Niger, Rwanda, Sierra Leone and Zimbabwe over the period 1970–2010.[1] To this end, we consider time series analysis, including structural break(s) and cointegration modelling.

The contribution of our article to the related literature is twofold. First, to the best of our knowledge, this is the first study that empirically examines the effects of all globalisation outcomes together (trade openness and FDI) and diversification of exports) on the real output in 11 LDCs, separately. In this context, it is important to obtain empirical results those are based on these three variables, due to the fact that LDCs have instable economic conditions and vulnerability in the trade liberalisation process, compared to developed economies and major developing countries. Moreover, LDCs need more sustainable economic growth in the long-run.

Second, this article focuses 11 LDCs, which have different economic conditions, macroeconomic positions, dynamics of output growth, and policies of international trade. Our time-series analyses address not only heterogeneity among these countries, but also tests whether their real output patterns have similarly been affected by trade openness, FDI, and diversification of exports. So, the econometric methodology of this article checks whether the related 11 LDCs have similar determinants in the pattern of the real output. Economically speaking, the current literature has so far not systemically investigated the co-existence impact of trade openness, FDI, and export diversification on the real output in LDCs. For instance, Tekin (2012) has examined the causal relationships among exports, FDI, and real income in the LDCs. He observed that FDI positively contributes to the economic growth. However, we still do not know how product diversification of exports and trade openness could have affected such a relationship. Therefore, using time series analysis, including structural break(s) and cointegration modelling, this article enhances our knowledge on the influences of the related variables on the real output pattern in poor emerging economies. The results in this article highlight the dynamics of real output in each poor emerging economy is different, and these countries are quite heterogeneous in terms of real output patterns.

The remainder of this article is organised as follows: Section 2 briefly explains the theoretical background and reviews the related literature. Section 3 explains the data and the econometric methodology as well as it sets the empirical models. Section 4 discusses the empirical results. Section 5 concludes.

2. Theoretical background and literature survey

In this study, we focus on 11 sub-Saharan LDCs that due to their economic structures have fragilities. In addition, these countries face big challenges as social problems, hunger, and inadequate human capital. The UN has organised three important events that take into account these characteristics of LDCs. The main emphasis of each event is that the contribution of export earnings and FDI inflows to real income in the LDCs (Tekin, 2012). Soaring inflation rates, sudden increases in the external debt, sharp declines in GDP growth rate, the sharp decline in global demand, and severe unemployment are the five main problems of this country group (UN, 2011b). The possible positive effects of trade openness, FDI and diversification of exports on the output (income) level or economic growth are important policy tools for the LDCs to overcome such problems.

2.1. *Trade openness, FDI and economic growth*

Trade openness affects the level of real output in different ways. According to the export-led growth hypothesis, efficiency improvements can be achieved by relocating of resources. Industrialisation of production provides an increase in gross domestic product (GDP) per capita and creates new employment opportunities and promotes exports. Considering the aspect of exports, an increase in exports will positively affect the total output. In addition, intermediate goods or equipment imports, which can increase efficiency and effectiveness in industrial production, also provide a significant contribution to the economic performance in poor countries (Wacziarg & Welch, 2008). Along with trade openness, FDI has a significant influence on the real income, particularly in the LDCs. The LDCs generally have lower physical capital, human capital and domestic savings, they also face high population growth rates. The technological diffusion effect is also quite slow in these countries and one of the primary benefits of FDI to the host country is that to produce additional capital to investments. Therefore, FDI significantly contributes to countries that have inadequate domestic savings. According to the UN (2011a), given the savings deficit of LDCs, FDI has great importance in settling the productivity gap.

Two views of the effects of FDI on the real income exist in the literature. First, according to the 'dependency theory', although FDI promotes the real output in the short-run, it will be able to generate various instabilities in the host country in the long-run (Tsai, 1994). Indeed, trade liberalisation failure that arises from political instability and inefficient policy choices for the integration of global markets has also devastated consequences in poor countries (Bigsten & Durevall, 2003). Second, according to the 'modernization theory', FDI provides additional capital to promote the level of real output (Tsai, 1994). The impacts of FDI on real output depend on economies of scale in the domestic market, as a result of the spillover effects and contribute to increase in value-added output in the manufacturing sector in the host country. In addition, the absorptive capacity of the country and to what extent the home country can carry advanced technology, have great importance in terms of real output pattern (Borensztein, De Gregorio, & Lee, 1998). Another impact of FDI is to yield an increase of trade volumes between the host and the home countries. This increase leads to get more information about investment opportunities in the host country (Basu, Chakraborty, & Reagle, 2003).

In addition, in the neoclassical growth models, FDI and trade openness can only affect real output as long as they positively contribute to technology (Makki & Somwaru, 2004). On the other hand, according to the endogenous growth models, FDI and trade openness can spur real income by increasing returns in production with the creation of spillover effects and externalities. In these models, FDI and trade openness significantly influence on the human capital level and technology division of the host country (Ahmed, Cheng, & Messinis, 2011). The spillovers of FDI and trade openness lead to the real income growth in the long term as well as they positively contribute to the increased skills of labour and management in the host country. The technological diffusion effect is also quite slow in the low-income countries (LIC), and one of the primary benefits of FDI in the host country is to produce additional capital to investments. Therefore, FDI significantly contributes to countries that have inadequate domestic savings. According to the UN (2011a), given the savings deficit of LDCs, FDI has great importance in settling the productivity gap. In short, FDI brings new technologies, know-how, new capabilities, and research and development

activities to the host country. Additionally, it contributes to increasing of factor productivity level in the host country (Iamsiraroj, 2016).

2.2. Export product diversification and economic growth

The importance of the diversification of exports has increased since the 1950s, when the Singer–Prebisch hypothesis states that the concentration of primary commodities disrupts terms-of-trade and causes instability in the export earnings. These issues negatively affected the real output. The classical trade theory emphasises that countries should specialise in the export products, in which they have comparative advantages. In early 1950s, this conception left its place to a new aspect that emphasises that a country needs to diversify its export products. Starting from the 1980s, many developing countries have leant exports basket of primary commodities to manufacturing goods. Exports have a great importance in terms of the real output, and the issue is more important for LDCs to provide macroeconomic stability. In short, the diversification of exports stabilises export earnings and provides an opportunity for faster growth rate in real output. In addition, it is important for these LDCs to diversify their primary export basket in order to stabilise export revenues and provide sustainable output growth (UN, 2004). Furthermore, it not only contributes to increases in the export revenues, but also yields to a rise in the value added of industrial products. The diversification of exports also provides externalities, which lead to changes in the export structure. This will contribute to a higher economic growth rate in the long-run (Al-Marhubi, 2000).

However, the LDCs generally specialises in exports of few essential primary commodities. Adverse events occurring in the global market directly affect their baskets of exports and leading to a reduction in the export revenues as well they experienced quick jumps in the unemployment rates and bust in the investments (UN, 2004). One of the ways of preventing these adverse effects is to diversify the export basket. For instance, the high rate of unemployment, which is one of the biggest problems in LDCs, is inversely related to increased diversification of exports by adding value to primary products (UN, 2014).

2.3. Previous papers on globalisation–economic growth nexus

The papers that explain the relationship between trade openness and real output illustrate different results.[2] Characteristics of econometric methodology, empirical models, and selected time period are the main sources of these differences. While some empirical studies suggest that there is a significant positive correlation between the trade openness and the real income (Greenaway, Morgan, & Wright, 2002; Wacziarg & Welch, 2008), this issue is still much-debated in the literature, and seems to be complex at least in cases of the low-income countries (Rodriguez & Rodrik, 2001). In addition, there are numerous studies in the literature for examining the relationship between FDI and real output, but there is still no consensus on the subject. The relationship can be positive (Ahmed et al., 2011; Borensztein et al., 1998; Makki & Somwaru, 2004; Tekin, 2012), bidirectional (Basu et al., 2003), and statistically insignificant (Tsai, 1994) in the cases of different countries or country groups. A country's political, social, and cultural factors play an important role in the occurrence of these different results. The increase in the number of export products or sectors also leads to a faster growth rate for the real output. For instance, in the seminal

study on 34 sub-Saharan African countries over the period 1960–1986, Gyimah-Brempong (1991) observed that fluctuations in export revenues adversely affect the level of output. Al-Marhubi (2000) indicated that increase in the diversification of exports leads to a rapid growth rate in the real income. The UN (2004) investigated the effects of the diversification index of exports on the real income in Bangladesh, Malaysia, Myanmar, and Nepal, and the study finds that the vertical product diversification positively affects the real income only in Bangladesh and Nepal. Gozgor and Can (2016) examined the effects of three diversification types (overall, extensive and intensive margins) on the real GDP per capita in the sample of 158 countries.[3] Considering the countries according to their income levels, they concluded that diversification of exports effect GDP per capita positively in the low-, the lower-middle- and the upper-middle-income countries.

3. Data, empirical model, and econometric methodology

3.1. Data

Our article examines the effects of trade openness, FDI, and product diversification of exports to real GDP per capita in 11 sub-Saharan African LDCs: Benin, Burkina Faso, the Democratic Republic of Congo, Kenya, Liberia, Madagascar, Malawi, Niger, Rwanda, Sierra Leone and Zimbabwe over the period 1970–2010. The selection of 11 LDCs in the data set is based on the availability of data, and we consider only the low-income and the sub-Saharan African countries, whose data for the whole period is available. The data set starts with the year of 1970, due to the fact that the time series in the diversification index of exports and FDI series are only available from that period.

We use the purchasing power parity (PPP) converted real GDP per capita in the USD in logarithmic form to measure the level of output. We also consider the real measure of trade openness (imports plus exports relative to the PPP GDP in the USD). Both data come from the Penn World Table (version 8.0). In addition, we use the net FDI inflows in USD (% of GDP) and obtain the data from the world development indicators of the World Bank. We also take into account the product diversification index of exports (Theil index) and the related data come from the statistics of the International Monetary Fund (IMF). A higher value of the Theil index means for a lower export diversification.[4] In Table 1, we illustrate the descriptive statistics of all variables for each country in the data set.

3.2. Empirical model

Following the globalisation–growth hypothesis (e.g., Tekin, 2012), we suggest that trade openness, FDI, and the export product diversification can be a significant determinant of income per capita in low-income economies. FDI leads to a higher capital and efficiency (productivity) in the economy and leads to a higher level of economy (Iamsiraroj, 2016). Trade liberalisation can positively affect the income level (Wacziarg & Welch, 2008). The diversification of exports can capture the effects of technology on the income level (Gozgor & Can, 2016). Therefore, the following empirical model for the income per capita can be written as such:

$$RGDPCH_t = f(OPEN_t^{\alpha_1}, FDI_t^{\alpha_2}, DIVE_t^{\alpha_3}) \tag{1}$$

Table 1. Summary of descriptive statistics.

Variables	Mean	Standard Dev.	Minimum	Maximum	Observations
Log of Real GDP per Capita (Benin)	7.14	0.11	6.92	7.41	41
Log of Real GDP per Capita (Burkina Faso)	6.53	0.16	6.27	6.87	41
Log of Real GDP per Capita (DR of. Congo)	6.10	0.56	5.29	6.85	41
Log of Real GDP per Capita (Kenya)	7.30	0.13	7.03	7.48	41
Log of Real GDP per Capita (Liberia)	6.35	0.63	4.88	7.14	41
Log of Real GDP per Capita (Madagascar)	6.80	0.14	6.57	7.04	41
Log of Real GDP per Capita (Malawi)	6.61	0.15	6.27	6.89	41
Log of Real GDP per Capita (Niger)	6.53	0.27	6.24	7.06	41
Log of Real GDP per Capita (Rwanda)	6.87	0.19	6.27	7.13	41
Log of Real GDP per Capita (Sierra Leone)	6.95	0.22	6.49	7.39	41
Log of Real GDP per Capita (Zimbabwe)	8.09	0.30	7.62	9.01	41
Real Trade Openness (%) (Benin)	18.6	5.10	11.3	30.6	41
Real Trade Openness (%) (Burkina Faso)	15.4	5.06	6.63	26.9	41
Real Trade Openness (%) (DR of Congo)	27.9	13.6	9.67	71.1	41
Real Trade Openness (%) (Kenya)	25.4	9.54	11.5	41.1	41
Real Trade Openness (%) (Liberia)	82.5	33.9	21.0	154	41
Real Trade Openness (%) (Madagascar)	24.2	10.5	10.1	46.0	41
Real Trade Openness (%) (Malawi)	25.7	6.08	12.3	39.8	41
Real Trade Openness (%) (Niger)	21.8	5.46	9.34	33.0	41
Real Trade Openness (%) (Rwanda)	8.54	2.67	3.44	14.7	41
Real Trade Openness (%) (Sierra Leone)	31.9	17.7	9.94	74.9	41
Real Trade Openness (%) (Zimbabwe)	12.4	9.68	0.31	50.8	41
Net FDI Inflows (% of GDP) (Benin)	1.03	1.41	−0.42	6.08	41
Net FDI Inflows (% of GDP) (Burkina Faso)	0.31	0.33	−0.12	1.43	41
Net FDI Inflows (% of GDP) (DR of Congo)	1.25	3.04	−1.75	13.2	41
Net FDI Inflows (% of GDP) (Kenya)	0.60	0.57	0.01	2.67	41
Net FDI Inflows (% of GDP) (Liberia)	16.8	29.8	−82.9	91.0	41
Net FDI Inflows (% of GDP) (Madagascar)	1.65	3.33	−0.19	12.4	41
Net FDI Inflows (% of GDP) (Malawi)	1.51	1.55	−1.30	5.07	41
Net FDI Inflows (% of GDP) (Niger)	1.37	2.88	−2.13	13.9	41
Net FDI Inflows (% of GDP) (Rwanda)	0.69	0.58	0.01	2.27	41
Net FDI Inflows (% of GDP) (Sierra Leone)	0.84	5.31	−28.6	9.24	41
Net FDI Inflows (% of GDP) (Zimbabwe)	0.66	1.17	−0.45	6.94	41
Theil Index: Export Diversification (Benin)	1.41	0.13	1.16	1.66	41
Theil Index: Export Diversification (Burkina Faso)	1.49	0.12	1.10	1.70	41
Theil Index: Export Diversification (DR of Congo)	1.47	0.07	1.34	1.66	41
Theil Index: Export Diversification (Kenya)	1.09	0.11	0.91	1.34	41
Theil Index: Export Diversification (Liberia)	1.58	0.07	1.47	1.73	41
Theil Index: Export Diversification (Madagascar)	1.32	0.12	0.77	1.48	41
Theil Index: Export Diversification (Malawi)	1.54	0.05	1.43	1.65	41
Theil Index: Export Diversification (Niger)	1.59	0.15	1.24	1.81	41
Theil Index: Export Diversification (Rwanda)	2.09	0.34	1.23	2.69	41
Theil Index: Export Diversification (Sierra Leone)	1.36	0.13	0.99	1.51	41
Theil Index: Export Diversification (Zimbabwe)	1.17	0.12	0.90	1.42	41

Source: Authors' calculations.

In this study, we estimate the following model using time-series test techniques:

$$RGDPCH_t = \beta_0 + \beta_1 OPEN_t + \beta_2 FDI_t + \beta_3 DIVE_t + \varepsilon_t \qquad (2)$$

where, $RGDPCH_t$ is log of real (PPP-converted) GDP per capita at 2005 constant USD prices, at time t; $OPEN_t$ is real trade openness measure at time t; FDI_t is net FDI inflows (% of nominal GDP) at time t; $DIVE_t$ is the value of the index of the product diversification of exports (the Theil index) at time t; and ε_t is the error term.

On the other hand, reaching a long-run equilibrium can take time for income per capita in LDC countries. In such case, the speed of adjustment between short-run and long-run income per capita level can also be modelled by the following error correction model (ECM):

$$\Delta RGDPCH_t = \alpha_0 + \sum_{i=1}^{n} \alpha_1 \Delta RGDPCH_{t-k} + \sum_{i=0}^{n} \alpha_2 \Delta OPEN_{t-k} + \sum_{i=0}^{n} \alpha_3 \Delta FDI_{t-k}$$

$$+ \sum_{i=0}^{n} \alpha_4 \Delta DIVE_{t-k} + \alpha_5 \varepsilon_{t-1} + \mu_t \qquad (3)$$

In Equation (3), Δ indicates the change in both dependent and independent variables, and μ_t is the error term. In addition, ε_{t-1} is the lagged error correction term (ECT) obtained from the estimation of Equation (2), and it represents the speed of adjustment of the disequilibrium between short-run and long-run levels of income per capita. It is expected that $\alpha_5 < 0$.

3.3. Econometric methodology

In the article, first, we run the unit root test of Perron (1997) that considers the unknown structural break in the time-series. We then use the maximum likelihood multivariate cointegration model of Johansen, Mosconi, and Nielsen (2000), including one structural break. Most used methods to analyse for the cointegration rank is the maximum likelihood cointegration modelling of Johansen.

However, the slope of the time trend may not be constant, due to time-varying economic variables, such as technology (export diversification) and trade liberalisation (trade openness). At this point, Johansen et al. (2000) generalise the maximum likelihood cointegration analysis, and propose the cointegration test distributions for the cases of known structural breaks in the data set. In this article, considering the global information criteria, we run the break point test of Bai and Perron (2003) to determine structural breaks in income per capita level.[5] Using these structural break dates, we implement the modified trace cointegration test of Johansen et al. (2000), where the critical values are computed for a single structural break (two regimes). The asymptotic critical values are also provided by Johansen et al. (2000) and Giles and Godwin (2012).

This article also uses the vector error correction (VEC) model to estimate the short-run coefficients and the ECT for the speed of adjustments to shocks. Note that the ECT is confirming the long-run connection between the variables. In addition, we consider the Granger non-causality test of the Toda and Yamamoto (1995). Thus, we check for the robustness of the results of the VEC model estimations. Finally, we run the Dynamic Ordinary Least Squares (DOLS) estimation technique of Saikkonen (1992) and Stock and Watson (1993) to obtain the long-run parameters in the cointegration modelling. We also consider the instability cointegration test of Hansen (1992) and the cointegration test of the added variables

of Park (1992). Thus, we check the econometric robustness for the empirical results of the DOLS estimations (Gozgor, 2014).

4. Empirical results

4.1. Results of the unit root test with the unknown structural-breaks

First, we test for unit roots in all time-series: log real GDP per capita, trade openness, FDI, and the diversification index of exports in each 11 LDCs, using the unit root test of Perron (1997) by considering both the constant and the time trend terms. We report the results in Table 2.

According to the results of the unit root test of Perron (1997) in Table 2, all variables in all countries, i.e., log real GDP per capita, trade openness, FDI, and the diversification index of exports can be described as a unit process. Therefore, we proceed to apply the cointegration modelling with structural break of Johansen et al. (2000).

4.2. Results of the cointegration test with the known structural breaks

We test for validity of the modified maximum likelihood cointegration modelling in the multivariate system for log real GDP per capita, trade openness, FDI, and the diversification index of exports in each 11 LDCs, respectively. We report the cointegration modelling with structural break of Johansen et al. (2000) in Table 3. The lag length selection is based on the AIC.

According to the results of the trace statistics for the cointegration test of Johansen et al. (2000) in Table 3, log real GDP per capita, trade openness, FDI, and the diversification index of exports are cointegrated at order one in Kenya, Liberia, Malawi and Sierra Leone. Therefore, we run the VEC model to obtain the short-run coefficients for the first difference variables in the related countries.[6]

4.3. Results of the vector error correction model and speed of adjustment to shocks

We estimate the VEC model to obtain the short-run coefficients in Kenya, Liberia, Malawi, and Sierra Leone. We report the results of the VEC model estimations in Table 4.

According to the results of the VEC model estimations in Table 4, the 1-point rise in the FDI inflows (% of GDP) is associated with the 0.036% rises in the real GDP output in Kenya in the short-run. Furthermore, a 1-point increase in the trade openness (% of GDP)

Table 2. Results of the unit root test of Perron (1997).

Constant & Time Trend Terms	Kenya	Liberia	Malawi	Sierra Leone
Log Real GDP per Capita	−2.60	−4.83	−3.78	−3.94
FDI	−4.72	−4.16	−5.28	−5.01
Trade Openness	−3.11	−3.46	−4.43	−5.26
Export Diversification Index	−4.58	−4.19	−5.40	−3.14

Notes: Critical values are −6.32 at the 1% significance level, and −5.59 at the 5% significance level. The null hypothesis of the unit root test of Perron (1997) is that time-series have a unit root with a structural break in both the constant and trend terms.
Source: Authors' calculations.

Table 3. Results of the bivariate cointegration test of Johansen et al. (2000).

	CV (5%)	Break: (1976)	
Log RGDP per Capita – FDI – Openness – Diversification (Kenya) (Lag = 1;			
Criteria: AIC) $\lambda_{\text{Trace statistics}}$			Decision
$H_0: r = 0\,versus\,H_1: r \geq 1$	49.12	54.69***	Rejected
$H_0: r \leq 1\,versus\,H_1: r \geq 2$	30.04	22.58	Not rejected
Log RGDP per Capita – FDI – Openness – Diversification (Liberia) (Lag = 1;	CV (5%)	Break: (1989)	
Criteria: AIC) $\lambda_{\text{Trace statistics}}$			Decision
$H_0: r = 0\,versus\,H_1: r \geq 1$	49.12	58.10***	Rejected
$H_0: r \leq 1\,versus\,H_1: r \geq 2$	30.04	29.45	Not rejected
Log RGDP per Capita – FDI – Openness – Diversification (Malawi) (Lag = 1;	CV (5%)	Break: (2000)	
Criteria: AIC) $\lambda_{\text{Trace statistics}}$			Decision
$H_0: r = 0\,versus\,H_1: r \geq 1$	49.12	49.16***	Rejected
$H_0: r \leq 1\,versus\,H_1: r \geq 2$	30.04	28.98	Not rejected
Log RGDP per Capita – FDI – Openness – Diversification (Sierra Leone)	CV (5%)	Break: (1996)	
(Lag = 1; Criteria: AIC) $\lambda_{\text{Trace statistics}}$			Decision
$H_0: r = 0\,versus\,H_1: r \geq 1$	49.12	51.62***	Rejected
$H_0: r \leq 1\,versus\,H_1: r \geq 2$	30.04	20.11	Not rejected

Notes: The cointegration models include the intercept and the linear and deterministic time trend terms. The trace test indicates that there is no cointegration at the 5% significance level. *** indicates significance levels at 1%.
Source: Authors' calculations.

Table 4. Results of the VEC model estimations and the speed of adjustment to shocks.

Regressors	Kenya	Liberia	Malawi	Sierra Leone
Δ (Lagged Log Real GDP per Capita)	0.227 (0.15)	0.435 (0.28)	−0.021 (0.18)	0.475 (0.28)
Δ (Lagged FDI)	0.036 (0.01)***	0.0005 (0.001)	0.011 (0.009)	0.001 (0.002)
Δ (Lagged Trade Openness)	0.0001 (0.001)	0.006 (0.002)***	−0.006 (0.003)**	−0.0001 (0.002)
Δ (Lagged Export Diversification)	0.002 (0.07)	−0.378 (0.59)	−0.452 (0.32)	−0.046 (0.02)**
Lagged Error Correction Term (ECT)	−0.031 (0.02)*	−0.006 (0.003)*	−0.068 (0.03)**	−0.118 (0.05)**
Adjusted R-squared	0.301	0.265	0.227	0.237
Log Likelihood	72.13	9.071	51.13	43.37

Notes: Dependent variable is the first difference (Δ) real GDP per capita in logarithmic form. The constant term is also estimated, but not reported. Standard errors are in parentheses. ***, **, and * indicate significance levels at 1%, 5%, and 10%, respectively.
Source: Authors' calculations.

leads to 0.006% increase in the real output in Liberia in the short-run. We also find that a 1-point increase in the trade openness (% of GDP) leads to 0.006% decrease in the real output in Malawi in the short-run.

Furthermore, a 1-point increase in the diversification index of exports (Theil index) leads to 0.046% increase in the real GDP per capita in Sierra Leone in the short-run. Recall that a higher value of the Theil index means for a lower export diversification. We observe that the sign of the relationship is negative. Therefore, diversification of exports positively contributes to the real GDP per capita in Sierra Leone.

On the cointegration modelling, we also compute the speed of adjustment to shocks, considering the ECT, and it is responsible to show the long-run connection among variables. The speeds of the adjustment to shocks are statistically significant, and they are −0.031, −0.006, −0.068, and −0.118 in Kenya, Liberia, Malawi and Sierra Leone, respectively. Note that the ECT is confirming the long-run connection between the variables. The main importance of the results is that the diversification of exports has relatively larger ECT parameter estimation for the real GDP per capita in Sierra Leone. This result indicates that the diversification of exports and the real GDP per capita are strongly linked in Sierra Leone.

4.4. Results of the Granger non-causality test

We also consider the first differences of all the variables in the Granger non-causality (exogenous variables) test of the Toda and Yamamoto (1995). We report the related results in Kenya, Liberia, Malawi and Sierra Leone in Table 5.

The results of the Granger non-causality test of the Toda and Yamamoto (1995) in Table 5 state that there is a statistically significant Granger causality relationship from FDI to real output in Kenya. The results also show that there is a significant Granger causality that runs from real trade openness to log real GDP per capita in Liberia and Malawi. In addition, the empirical results indicate that product diversification of exports causes to real output in Sierra Leone. These results are in line with the results of the VEC model estimations. Therefore, we can suggest that the empirical results in the short-run are statistically robust for these countries.

4.5. Results of the dynamic ordinary least squares estimations

We also run the DOLS estimation technique to obtain the long-run parameters in the cointegration modelling in Kenya, Liberia, Malawi and Sierra Leone. We report the results of the DOLS estimations in Table 6.

According to the results of the DOLS estimations in Table 6, the 1-point rise in FDI inflows (% of GDP) is associated with the 0.193% rise in real output in Kenya in the long-run. Furthermore, 1-point increase in trade openness (% of GDP) leads to 0.013% increase in real output in Liberia in the long-run. We also find that the negative relationship between trade openness and log real GDP per capita in Malawi is statistically insignificant in the long-run. Furthermore, the 1-point increase in the diversification index of exports (Theil index) leads to a 0.133% increase in the real output in Sierra Leone in the long-run. Again, the sign of the relationship is negative, and diversification of exports positively contributes to the real GDP per capita in Sierra Leone.

4.6. Discussion and policy implications

LDCs are more vulnerable to external shocks, and the empirical results indicate that FDI and trade openness can be a buffer to ease the impacts of external shocks in Kenya and Liberia. In other words, these results highlight the importance of FDI and trade openness

Table 5. Results of the Granger non-causality test.

LDCs	Granger Non–Causality Test	Chi-square-Stat	Probability
Null hypothesis:	Trade Openness does not cause Real Output in Kenya	0.004	(0.9497)
Null hypothesis:	FDI does not cause Real Output in Kenya	6.081**	(0.0137)
Null hypothesis:	Export Diversification does not cause Real Output in Kenya	0.001	(0.9791)
Null hypothesis:	Trade Openness does not cause Real Output in Liberia	7.098***	(0.0077)
Null hypothesis:	FDI does not cause Real Output in Liberia	0.226	(0.6338)
Null hypothesis:	Export Diversification does not cause Real Output in Liberia	0.409	(0.5221)
Null hypothesis:	Trade Openness does not cause Real Output in Malawi	4.680**	(0.0305)
Null hypothesis:	FDI does not cause Real Output in Malawi	1.532	(0.2157)
Null hypothesis:	Export Diversification does not cause Real Output in Malawi	1.994	(0.1578)
Null hypothesis:	Trade Openness does not cause Real Output in Sierra Leone	0.005	(0.9421)
Null hypothesis:	FDI does not cause Real Output in Sierra Leone	0.352	(0.5526)
Null hypothesis:	Export Diversification does not cause Real Output in Sierra Leone	10.81***	(0.0010)

Notes: The *p*-values are in parentheses. *** and ** indicate significance levels at 1% and 5%, respectively.
Source: Authors' calculations.

Table 6. Results of the DOLS estimations.

Real GDP per Capita (Log)	Kenya	Liberia	Malawi	Sierra Leone
Foreign Direct Investments	0.193 (0.042)***	0.013 (0.008)	0.051 (0.044)	0.008 (0.015)
Trade Openness	−0.011 (0.009)	0.013 (0.004)***	−0.004 (0.005)	−0.007 (0.004)
Export Diversification	−0.253 (0.206)	−0.213 (0.221)	−0.217 (0.166)	−0.133 (0.061)**
Lags & Leads	(1,1)	(1,1)	(1,1)	(1,1)
Adjusted R-squared	0.864	0.799	0.674	0.746
Normality	0.012 [0.99]	1.718 [0.42]	0.971 [0.61]	2.174 [0.33]
Hansen Instability	0.146 [$p > 0.2$]	0.028 [$p > 0.2$]	0.151 [$p > 0.2$]	0.033 [$p > 0.2$]
Park Added Variables	3.435 [0.13]	0.574 [0.44]	0.911 [0.34]	0.352 [0.55]

Notes: Dependent variable is the real GDP per capita in logarithmic form. The constant term and the linear time trend term are also estimated but not reported. The Hansen Instability refers to the LM statistic for the parameter instability test of Hansen (1992) (null hypothesis: series are cointegrated). The Add Variables refers to the cointegration test of Park (1992) (null hypothesis: series are cointegrated). The coefficient covariance matrix is calculated by the Barlett Kernel and the bandwidth selection method of Andrews. The standard errors are given in parentheses and the probability values are given in brackets. *** and ** indicate significance levels at 1% and 5%, respectively.
Source: Authors' calculations.

on sustainable real output growth pattern in Kenya and Liberia. The empirical results on the positive effect of trade openness on real income in the least developed economies are in line with the previous results of Greenaway et al. (2002) and Wacziarg and Welch (2008). In addition, the result of the significant impact of FDI on the real income is in line with previous results of Borensztein et al. (1998), Makki and Somwaru (2004), and Tekin (2012). Among these studies, our results are particularly in parallel with the findings of Tekin (2012), due to the evidence that there are statistically and economically significant effects of FDI on real income in several LDCs.

However, free trade with the rest of the world is harmful to the real income pattern in Malawi in the short-run, but it disappears in the long-run. These results imply that the Malawian economy is vulnerable to the trade shocks; therefore, they should implement policies to avoid trade shocks. This effect may come from the issue that exports of the Malawian economy are based on unstable markets. In other words, this result can be related to the fact that exports of Malawi depend on a single commodity (tobacco) in general (UN, 2004, 2014).

In addition, we find that the product diversification of exports promotes the real GDP per capita in Sierra Leone. This result means that heading for high value-added products and expanding the export basket through such products are prominent for sustainable real output growth pattern in Sierra Leone. To successfully achieve diversification of exports, some certain economic variables, i.e., human capital, physical infrastructure, and technology are necessary to provide sustainable real income growth pattern via the product diversification of exports. Indeed, most LDCs have still not capacity to stimulate these economic variables and parameters. However, we observe that Sierra Leone is an exceptional case for achieving diversification of exports to promote its level of real GDP per capita.

5. Conclusion

In this article, we examined the effects of trade openness, FDI, and product diversification of exports to the real GDP per capita in 11 LDCs over the period 1970–2010. We found that the long-run relationship only exists in Kenya, Liberia, Malawi and Sierra Leone. We observed that FDI spurs the level of real output in Kenya and trade openness positively

contributes to real output in Liberia. In addition, trade openness is negatively associated with real GDP per capita in Malawi in the short-run, but there is no statistically significant relationship in the long-run. Finally, we demonstrated that the product diversification of export promotes the level of real output in Sierra Leone. From a policy perspective, we observed that FDI, trade openness, and diversification of exports are crucial to promote real GDP per capita levels in Kenya, Liberia, and Sierra Leone, respectively. For another seven countries, we observed that different aspects of globalisation are not significantly determines the real per capita GDP in the long-run.

The results of this article highlight that the dynamics of real output pattern for each LDC are different, and these countries are heterogeneous. Therefore, it can be important to run time series analysis to examine the dynamics of real output pattern in each poor economy.

Finally, we need to note that every county has still different dynamics, i.e., macroeconomic policies, resource endowments, legal regulations, and institutional quality, in attracting FDI, enhancing international trade, and expanding export basket. Therefore, more research should address the role of additional economic and political variables with the effects of trade openness, FDI, and product diversification of exports on real output patterns or economic growth in the least developed economies.

Notes

1. In 2015, there were 34 LICs in the World Bank database, and 26 of them are in sub-Saharan Africa. It is important to note that the selection of the countries in this article is not arbitrary. We focus on the low-income sub-Saharan African countries with at least 40 years observations of the relevant variables. We also need continuous time-series for each control variable in the cointegration analysis.
2. See Potrafke (2015) for the recent literature review of globalisation and growth linkage.
3. See Gozgor and Can (2016) for a recent literature review on export product diversification–economic growth nexus.
4. Therefore, if we observe that the diversification of exports positively contributes to the economic growth, this means the sign of the relationship is negative (Gozgor & Can, 2016).
5. In other words, we incorporate endogenous structural breaks in the cointegration test of Johansen et al. (2000); therefore, there is no distortion in the critical values for the null hypothesis (Giles & Godwin, 2012).
6. The results on Vector Autoregressive (VAR) in seven countries can be added to the Appendix, but this article focuses the analysis on countries where cointegration is found. In addition, we neglect the results on VAR due to the page constraints.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix I. Results on seven countries.

Table A1. Results of the unit root test of Perron (1997).

Constant & Time Trend Terms	Benin	Burkina Faso	DR of Congo	Madagascar	Niger	Rwanda	Zimbabwe
Log Real GDP per Capita	−4.48	−3.95	−3.44	−3.28	−4.95	−4.56	−4.14
FDI	−4.79	−5.26	−2.55	−4.42	−4.42	−3.51	−3.37
Trade Openness	−4.64	−4.38	−3.45	−3.09	−4.24	−5.25	−5.17
Export Diversification	−3.49	−4.71	−4.54	−5.32	−4.82	−5.52	−4.71

Notes: Critical values are −6.32 at the 1% significance level, and −5.59 at the 5% significance level. The null hypothesis of the unit root test of Perron (1997) is that time-series have a unit root with a structural break in both the constant and trend terms.
Source: Authors' calculations.

Table A2. Results of the bivariate cointegration test of Johansen et al. (2000).

Log RGDP per Capita – FDI – Openness – Diversification (Benin)				
(Lag = 1; Criteria: AIC) $\lambda_{\text{Trace statistics}}$		CV (5%)	Break: (1987)	Decision
$H_0: r = 0$ versus $H_1: r \geq 1$		49.12	45.87	Not rejected
$H_0: r \leq 1$ versus $H_1: r \geq 2$		30.04	19.44	Not rejected
Log RGDP per Capita – FDI – Openness – Diversification (Burkina Faso)				
(Lag = 1; Criteria: AIC) $\lambda_{\text{Trace statistics}}$		CV (5%)	Break: (1987)	Decision
$H_0: r = 0$ versus $H_1: r \geq 1$		49.12	40.43	Not rejected
$H_0: r \leq 1$ versus $H_1: r \geq 2$		30.04	18.58	Not rejected
Log RGDP per Capita – FDI – Openness – Diversification (DR of Congo)				
(Lag = 1; Criteria: AIC) $\lambda_{\text{Trace statistics}}$		CV (5%)	Break: (1989)	Decision
$H_0: r = 0$ versus $H_1: r \geq 1$		49.12	43.59	Not rejected
$H_0: r \leq 1$ versus $H_1: r \geq 2$		30.04	14.95	Not rejected
Log RGDP per Capita – FDI – Openness – Diversification (Madagascar)				
(Lag = 1; Criteria: AIC) $\lambda_{\text{Trace statistics}}$		CV (5%)	Break: (1988)	Decision
$H_0: r = 0$ versus $H_1: r \geq 1$		49.12	40.79	Not rejected
$H_0: r \leq 1$ versus $H_1: r \geq 2$		30.04	21.04	Not rejected
Log RGDP per Capita – FDI – Openness – Diversification (Niger)				
(Lag = 1; Criteria: AIC) $\lambda_{\text{Trace statistics}}$		CV (5%)	Break: (1983)	Decision
$H_0: r = 0$ versus $H_1: r \geq 1$		49.12	39.97	Not rejected
$H_0: r \leq 1$ versus $H_1: r \geq 2$		30.04	16.32	Not rejected
Log RGDP per Capita – FDI – Openness – Diversification (Rwanda)				
(Lag = 1; Criteria: AIC) $\lambda_{\text{Trace statistics}}$		CV (5%)	Break: (1993)	Decision
$H_0: r = 0$ versus $H_1: r \geq 1$		47.85	47.78	Not rejected
$H_0: r \leq 1$ versus $H_1: r \geq 2$		29.79	26.91	Not rejected
Log RGDP per Capita – FDI – Openness – Diversification (Zimbabwe)				
(Lag = 1; Criteria: AIC) $\lambda_{\text{Trace statistics}}$		CV (5%)	Break: (1987)	Decision
$H_0: r = 0$ versus $H_1: r \geq 1$		49.12	31.93	Not rejected
$H_0: r \leq 1$ versus $H_1: r \geq 2$		30.04	15.87	Not rejected

Notes: The cointegration models include the intercept and the linear and deterministic time trend terms. The Trace test indicates that there is no cointegration at the 5% significance level.
Source: Authors' calculations.