Economics Bulletin

Volume 43, Issue 3

The long and short run effects of foreign direct investment on economic complexity in Sub-Saharan African countries.

Jasnine Mogem Kouam
University of Dschang

Luc Nembot Ndeffo
University of Dschang

Mathurin Aimé Mekam Pouatcha
University of Bamenda

Abstract

This study examines the long and short run effects of foreign direct investment (FDI) on economic complexity using a sample of 21 Sub-Saharan African (SSA) countries over the period 1980-2017. The empirical evidence is based on the pooled mean group methodology. Results reveal a mixed impact of FDI on economic complexity. In particular, we found that FDI stimulates economic complexity in the long run whilst a negative relationship is observed in the short run. Remittances, corruption, health and GDP are found to be determinants of economic complexity. Furthermore, robustness checks show that regardless of the level of income our results are confirmed. Finally, our findings were robust when using the System Generalized Method of Moments (SGMM) as an alternative estimator.

The authors would like to thank Dr Njangang Ndieupa Henri and the anonymous referee for their helpful comments and contribution to this paper.

Citation: Jasnine Mogem Kouam and Luc Nembot Ndeffo and Mathurin Aimé Mekam Pouatcha, (2023) "The long and short run effects of foreign direct investment on economic complexity in Sub-Saharan African countries.", *Economics Bulletin*, Volume 43, Issue 3, pages 1421-1433

Contact: Jasnine Mogem Kouam - mjasnine@yahoo.fr, Luc Nembot Ndeffo - ndefluc@yahoo.fr, Mathurin Aimé Mekam Pouatcha - mekampouatcha@yahoo.fr.

Submitted: May 17, 2023. **Published:** September 30, 2023.

1. Introduction

Foreign Direct Investment (FDI) inflows to developing economies have substantially increased in the last two decades. FDI inflow to the African continent increased from $ 42 billion in 2017 to $ 45 billion in 2019 with Egypt being the largest recipient of FDI ($ 9 billion) for the same year (UNCTAD, 2020). For the specific case of Sub-Saharan Africa (SSA), FDI rose from $ 11.8 billion in 2001 to $ 32 billion in 2019, an increase of approximately 171.2 per cent. FDI is a vector of the structural transformation and modernization of the developing countries (Amendolagine, Coniglio, and Seric, 2017). In other words, this form of external capital is believed to be a very important drive for economic development.

An emerging strand of the literature in development economics posits that economic complexity[1] explains why some countries are prospering while others stay underdeveloped (Saadi, 2020). This raises an interesting question: Does FDI affects economic complexity in SSA countries? To answer this question, we use a sample of 21 Sub-Saharan African (SSA) countries from 1980-2017 and employ a pooled mean group methodology. Interestingly, we find that FDI inflow promotes economic complexity in the long-run while a contrasting result is documented in the short-run.

In fact, from a theoretical perspective, FDI might have a contrasting impact on the host country's economy depending on whether we are in the long or short run (Dinh et al. 2019). FDI might have a negative effect on economic development in the short run (Schoors, 2002; Dinh et al. 2019). This could be explained by the fact that, foreign firms might oust domestic unproductive competitors if there is a significant initial technology gap and poor human capital between the foreign and domestic firms. Conversely, FDI could produce a positive effect in the long run by contributing to technological transfer and know-how (Feulefack and Ngassam, 2020, Adegboye et al. 2020, Dinh et al. 2019, Schoors, 2002). Moreover, multinational enterprises can stimulate the host country's economic development by introducing highly sophisticated products (Kannen, 2019).

By focusing on the relationship between FDI and economic complexity, this research adds to a growing corpus of the literature which ascertains the role of FDI on economic development in the host country's economy. One strand of the literature finds a positive impact of FDI on economic complexity (Bin and Jiangyong, 2009; Sepehrdoust, Davarikish and Setarehie, 2019; Kannen, 2019; Khan et al. 2020; Nguéda and Kelly, 2022). On the contrary, other studies find that FDI does not promote economic complexity (Valette, 2018; Osinubi and Ajide, 2022). Therefore, we contribute to the literature by analyzing both the long and short run effects of FDI on economic complexity. To the best of our knowledge this is the first study which provides insight on the inter-temporal impact of FDI on economic complexity.

Following the introduction, the rest of this paper is structured as follows. The second section tackles the literature review while the empirical strategy is discussed in the third section. Furthermore, the fourth section presents the results and section 5 concludes.

2. Literature review

The surge in understanding the determinants of economic development has led economists to consider economic complexity as an efficient indicator for economic development (Kannen, 2019). However, economic complexity remains a new strand of the

[1] Economic complexity can be defined as "the diversified knowledge and structural transformation in an economy in order to more effectively utilize resources" (Payne et al, 2023). In other words, it reflects the level of sophistication of an economy's productive structure. Hidalgo and Hausmann (2009) elaborated a proxy for economic complexity called the economic complexity index (ECI). This indicator measures both the quantity and the ubiquity of a country's exports basket (Khan et al, 2020).

economic literature and empirical studies on the macroeconomic determinants of economic complexity are scarce (Khan et al., 2020).

The economic literature does not provide enough empirical evidence to clearly conclude on how FDI affects economic complexity. As earlier mentioned, the literature on the impact of FDI on economic complexity still remains mixed and inconclusive. That is, one strand of literature suggests a positive linkage between FDI and economic complexity while another shows no relationship between FDI and economic complexity. Bin and Jiangyong (2009) carried out a micro-based study to investigate the effect of FDI on Chinese exports' sophistication from 2000 to 2005. Findings show that the sophistication of Chinese exports is driven by foreign firms from the OECD countries. Sepehrdoust, Davarikish and Setarehie (2019) in an analysis to investigate the effect of trade liberalization on economic complexity over the period 2002-2017, used FDI as an explanatory variable. This research employs the panel vector auto regression model as econometric tool. They found that FDI has a positive impact on economic complexity in the Middle East developing economies. In the same vein, Kannen (2019) found that tertiary FDI promotes economic complexity. In fact, this study was conducted with the scope of investigating the sectoral impact of FDI on economic complexity. On the one hand, this study shows that, FDI directed towards the tertiary sector has a positive and significant impact on economic complexity while both primary and secondary FDI do not stimulate economic complexity. The authors argue that FDI enhances economic complexity when foreign goods are more sophisticated than domestic produced goods. Furthermore, Khan et al. (2020) found a positive linkage between FDI and economic complexity in China over the period 1985-2017. This result is corroborated by Nguéda and Kelly (2022).

On the contrary, other studies found that FDI does not stimulate economic complexity. Valette (2018) found that FDI has no effect on economic complexity. In fact, the author uses a system GMM estimator to estimate the linkage between migration and economic complexity. For this study, the author employs FDI as a control and results show a neutral relationship between FDI and economic complexity. Furthermore, Osinubi and Ajide (2022) finds that FDI deters economic complexity in BRICS countries.

3. Empirical strategy

3.1 Data and descriptive evidence

We use a sample of 21 SSA countries over the period 1980-2017. The 21 countries are: Angola, Cameroon, Democratic Republic of Congo, Republic of Congo, Cote d'Ivoire, Ethiopia, Gabon, Ghana, Guinea, Kenya, Madagascar, Mauritania, Mozambique, Namibia, Nigeria, Senegal, South Africa, Tanzania, Togo, Zambia, Zimbabwe. Our data were collected from different sources: the World Development Indicator (WDI), the Observatory of Economic Complexity, and the International Country Risk Guide (ICRG). The period of analysis was chosen based on the availability of data. Table 1 shows the summary statistics of the variables employed in this study.

Table 1: Summary statistics

Variables	Obs	Mean	Std. Dev.	Min	Max	source
ECI*	798	-0.9035015	0.3651674	-1.750319	0.2990707	MIT's Obs
FDI	767	2.765311	5.155332	-8.70307	49.99791	WDI
Rem	648	1.394065	2.367479	0.0001832	13.61145	WDI
GDP	777	0.5998184	4.886424	-26.41177	20.0408	WDI
IMR	798	77.79825	30.69769	28.2	177.5	WDI
Corr	670	2.388495	1.041659	0	6	ICRG

Notes: (*) this variable is expressed in logarithm. ECI: economic complexity index, FDI: foreign direct investment, Rem: remittances, GDP: gross domestic product, Corr: corruption and IMR: infant mortality rate.

For our regression analysis, we used an annual dataset, our dependent variable is economic complexity measured by the economic complexity index (ECI). It measures the diversity and the sophistication of a country's export structure, adjusted for the difficulty of exporting each product. ECI is found in the MIT's Economic Complexity Observatory. Figure 1 displays the evolution of economic complexity over a given period and reveals that the mean values are around the median values. This shows that the distribution is approximately normal. Moreover, we observe that there is no extreme outlier in our sample.

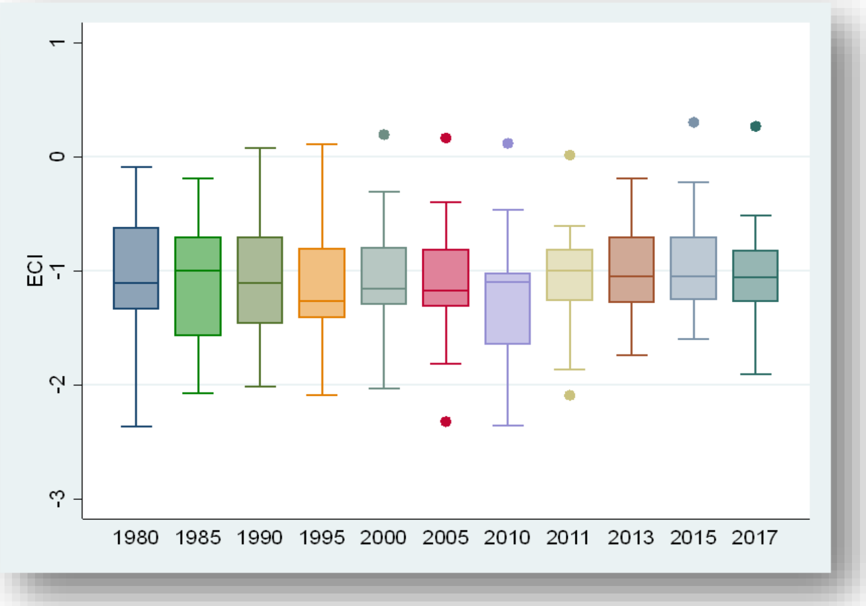

***Fig. 1:** ECI over 1980 to 2017 in SSA*
***Source:** MIT's Observatory of Economic Complexity and author's estimation.*

3.2 Methodology

Our baseline model is inspired from the literature on economic complexity (Kannen, 2019; Saadi, 2020). We estimate the dynamic link between FDI and economic complexity using a panel ARDL specification. The advantages of employing this method are manifold. First, it addresses potential endogeneity bias. Also, by including individual-specific effects, it is possible to control for heterogeneity in the linkage between the dependent variable and the controls across countries. Moreover, it enables us to investigate both the long and short run relationship between FDI and economic complexity. Lastly, we obtain consistent estimates even in the case where variables are integrated with different orders, that is, I (0) and I (1). Hence, the basic model by Pesaran and Shin (1996), is the panel autoregressive distributed lag (ARDL) is given as:

$$a_{it} = \sum_{j=1}^{p} \gamma_{ij}\, a_{i,t-j} + \sum_{j=0}^{q} \delta'_{ij}\, X_{i,t-j} + \mu_i + \varepsilon_{it} \qquad (1)$$

Where i = 1, 2, 3……., N stands for the country index and t = 1, 2…….., T the time, j represents the number of lags, a_{it} is the economic complexity index, X_{it} a vector containing all the explanatory variables, μ_i represents country specific fixed effects.

We can re-parameterize Equation (1) to consider the long run and the adjustment coefficients as shown below:

$$\Delta a_{it} = \emptyset_i(a_{i,t-1} - \emptyset'_i x_{i,t}) + \sum_{j=1}^{p-1} \gamma_{it}\, \Delta a_{i,t-j} + \sum_{j=0}^{q-1} \delta'_{ij}\, \Delta x_{i,t-j} + \mu_i + \varepsilon_{it} \qquad (2)$$

Where $\emptyset_i$ is the error-correcting speed of adjustment. That is, it measures the speed of adjustment of economic complexity following a change in FDI. For us to confirm the existence of a long run relationship between economic complexity and the regressors, $\emptyset_i$ must be negative and significant ($\emptyset_i$ <0). Therefore, if $\emptyset_i$ = 0 then there exist no long run relationship between economic complexity and FDI. Equation (2) above is our baseline model and allows us to understand the relationship between FDI and economic complexity. Three different estimators were used: Pooled Mean Group (PMG), Mean Group (MG), and Dynamic Fixed Effects (DFE). It should be noted that our preferred estimator PMG was chosen based on the results of the Hausman test. The PMG yields more consistent results compared to other estimators. In fact, in the case of small samples and under slope homogeneity, the DFE estimator may suffer from potential heterogeneity bias (Pesaran and Smith, 1995). Therefore, Pesaran, Shin and Smith (1999) present the PMG as a consistent estimator. This is because; it restricts long run parameters to be identical over the cross section, but allows the intercept, error variances and short run coefficients to vary across groups on the cross section. Moreover, the MG yields biased estimates in the presence of long run homogeneity restrictions. To address this issue, Pesaran et al. (1999) propose the Maximum likelihood-based PMG approach. As a robustness check we employ an alternative estimator, the System Generalized Method of Moments (SGMM). This is because there might exist a correlation between the lagged dependent variable and the fixed effects in the error term resulting to the dynamic panel bias (Nickell, 1981). Hence, we correct this problem by using the SGMM (Arellano and Bover, 1995; Blundell and Bond, 1998) which employs both internal and external instruments. The Hansen's test of over-identifying restrictions and the Arellano-Bond's test ensure no-second order serial correlation.

4. Results

4.1 Preliminary results

It is important to carry out a series of preliminary tests before estimating our models using the PMG estimator. We begin by verifying if the countries in the sample are dependent or not. To do this, we carry out both the Pesaran's (2004) cross-sectional dependence test (CD) and the Lagrange Multiplier (LM) test by Breusch and Pagan (1980).

Table 2: Dependence test

Cross Sectional Dependence test of Breusch-Pagan LM, Pesaran Scaled LM and Pesaran CD			
Variables	**Breusch-Pagan LM**	**Pesaran Scaled LM**	**Pesaran CD**
lnECI	735.3534***	25.63462***	0.191
FDI	842.2610***	30.85118***	21.571***
Rem	2646.389***	118.8836***	21.675***
GDP	598.5203***	18.95785***	15.303***
IMR	6438.233***	303.9066***	79.574***
Corr	1779.210***	81.52476***	23.553***

Note: *** Denotes statistical significance at the 1% level

Table 3 : Homogeneity test

	Statistic	p-value
$\tilde{\Delta}$	1.695	0.090
$\tilde{\Delta}adj$	-1.950	0.051

Note: $\tilde{\Delta}$ and $\tilde{\Delta}adj$ are suitable for large and small samples, respectively. $\tilde{\Delta}adj$ is the mean variance bias adjusted version of $\tilde{\Delta}$. Standard delta test ($\tilde{\Delta}$) requires error not to be autocorrelated.

However, our results are based on the Lagrange multiplier (LM) test by Breusch and Pagan (1980). This test is efficient when the number of time periods is greater than the number of cross-sectional units (T>N) (Ahmad et al, 2023). Table 2 displays the results of the cross-sectional dependent test. We find strong evidence of cross-country dependence on variables, FDI, REM, GDP, IMR and Corr.

Moreover, we carry out the homogeneity test by Pesaran and Yamagata (2008). The results of the homogeneity test are shown on Table 3. We find evidence of slope heterogeneity. We then proceed to test for the existence of a unit root. The panel unit root tests are helpful in choosing the model which is suitable for the data used in the study. Before testing for cointegration (long run relationships), the study employed several approaches to test for unit root in the panel data, namely, the Critical Fisher-Augmented Dickey-Fuller (CADF), Im, Pesaran and Shin (2003) (IPS); and (Maddala and Wu, 1999). Table 4 presents the different tests for the variables at level and first difference. The Im, Pesaran and Shin and the Fisher Maddala and Wu tests show that REM, IMR and Corr are I (1) whilst ECI, FDI, GDP are I (0). However, given the fact that we found evidence of cross-section dependence, the CADF test by Pesaran (2007) is the most appropriate test to detect unit-root. Hence, the CADF-Pesaran confirms that all our variables are non-stationary.

Table 4: Panel Unit Root test

	Test of 1st generation				Test of 2nd generation	
	IPS (2003)		Fisher maddala et wu (1999)		CADF Pesaran (2003).	
variables	**Level**	**1st Difference**	**Level**	**1st Difference**	**Level**	**1st Difference**
lnECI	(-4.44) ***	(-17.10) ***	(-4.8048) ***	(-18.0371) ***	(-1.732) *	(-13.192) ***
FDI	(-4.11) ***	(-21.52) ***	(-4.4300) ***	(-21.9437) ***	(-6.354) ***	(-16.035) ***
Rem	(-0.12)	(-12.71) ***	(-0.0517)	(-13.9071) ***	(-1.901) *	(-10.331) ***
GDP	(-8.50) ***	(-24.84) ***	(-9.2506) ***	(-24.9335) ***	(-8.547) ***	(-18.950) ***
IMR	(-0.67)	(-4.23) ***	(-1.1024)	(-4.4655) ***	(-7.564) ***	(-2.308) *
Corr	(-0.34)	(-10.66) ***	(-0.3886)	(-11.6323) ***	(-3.540) ***	(-10.249) ***

Note: ***, ** and * are statistical significance at the 1%, 5% and 10% levels, respectively.

After previously obtaining conclusive results for different tests (Dependence, homogeneity and unit root tests), we proceed to test for co-integration using Westerlund (2007). The Pedroni's test (Pedroni 1999, 2004) is included as an alternative method but we prefer the Westerlund's test because it takes into account inter-individual dependency. The results of the Pedroni and Westerlund tests are displayed in Table 5a and 5b respectively. Based on Westerlund's test, findings indicate that we can reject the null hypothesis of no co-integration. Therefore, we find evidence of a long-run relationship between variables.

Table 5a: Pedroni test of Co-integration test

Pedroni	Statistic	P-value
Modified PP t	1.1930	0.1164
PP t	-2.7849	0.0027
ADF t	-1.8629	0.0312

Note: The lag lengths are selected using AIC.

Table 5b: Westerlund test of cointegration

Statistic	Value	Z-value	P-value
Gt	-2.497	-3.672	0.000
Ga	-11.749	-3.878	0.000
Pt	-11.239	-4.632	0.000
Pa	-11.154	-7.147	0.000

Note: Average AIC selected lag length: 0.43, Average AIC selected lead length: 0.14, Results with 21 series and 1 covariate for H0: no cointegration.

4.2 Baseline results

Our baseline results are displayed in Table 6 where columns 1, 2 and 3 show regression results when using PMG, MG and DFE respectively. Our results are shown in column 1 when using the PMG estimator. The overall findings reveal that FDI has a positive relationship with economic complexity (ECI) in SSA. In fact, the long run coefficient of FDI is positive and statistically significant. This result could be explained by the fact that, the inflow of FDI promotes economic complexity in the region through the transfer of skills, knowledge and technology. More specifically, it takes time for new technological know-how to be assimilated by domestic enterprises. Our findings on the positive linkage between FDI and economic complexity in the long run are consistent with Kannen (2019); Sepehrdoust et al. (2019); Khan et al. (2020) and Nguéda and Kelly (2022). Regarding the controls, remittances have a negative impact on economic complexity. The coefficient of remittances is negative and statistically significant at 1% level. This is contrary to the result obtained by Saadi (2020). The author suggests that migrant remittances promote ECI through investment in productive activities and entrepreneurial self-discovery. On the other hand, our result could be explained by the fact that remittances can lead to the reduction of labor force participation in the recipient country. In fact, receiving families may replace labor income by the received funds. This might simultaneously lead to an increase in workers' leisure time and a reduction in labor force participation (Eggoh, Bangake and Semedo, 2019). Furthermore, the coefficient of corruption is negative and statistically significant. This suggests that an increase in corruption reduces the level of economic complexity. This can be due to the fact that high corruption levels reduce both investment in new products and human capital development, hence deterring economic complexity. This result is consistent with Kannen (2019). Moreover, we find a long run negative relationship between growth and economic complexity. This result could be explained by the fact that the economies of this region are largely based on unsophisticated goods. Hence an increase in growth causes a reduction in economic complexity. Our results are contrary to Yaprakli and Ozden (2021) who found a positive relationship between GDP per-capita and economic complexity. The coefficient on infant mortality is negative and statistically significant, suggesting that an increase in infant mortality will lead to a decrease in economic complexity. This reflects the fact that a good population health (captured by infant mortality) stimulates the sophistication of goods.

Regarding the short run effects, we found contrasting results on the relationship between FDI and economic complexity. In particular, our results reveal that FDI deters economic complexity. This could be explained by the fact that in the short run, multinational enterprises oust domestic firms from the market thereby negatively affecting economic complexity. This finding is similar to Osinubi and Ajide (2022) who found a negative relationship between FDI and economic complexity for the particular case of BRICS countries.

Hence, our baseline results provide evidence of the inter-temporal impact of FDI on economic complexity. More specifically, we found that the impact of FDI on ECI is mixed depending on whether we are in the short or long run.

Table 6: Long and short run impact of FDI on economic complexity

	lnECI	lnECI		lnECI
VARIABLES	PMG	MG	Hausman test	DFE
Long run coefficients				
FDI	0.0161***	0.0221	2.30	0.00242
	(0.00165)	(0.0173)	(0.8065)	(0.00597)
Rem	-0.0178***	-0.172		0.00866
	(0.00358)	(0.207)		(0.0125)
Corr	-0.0372***	-0.00833		0.0128
	(0.0126)	(0.0504)		(0.0325)
GDP	-0.00554***	-0.0170		-0.00222
	(0.00203)	(0.0113)		(0.00734)
IMR	-0.00302***	0.00420		0.000790
	(0.000620)	(0.00395)		(0.00165)
ECT*(Phi)*	-0.480***	-0.689***		-0.276***
	(0.0778)	(0.122)		(0.0306)
Short run coefficients				
D.FDI	-0.00793*	-0.0112		-0.000182
	(0.00465)	(0.0109)		(0.00156)
D.Rem	0.00539	0.117		0.00542
	(0.121)	(0.156)		(0.00751)
D.GDP	-0.000895	0.00663		-0.00213
	(0.00149)	(0.00419)		(0.00156)
D.Corr	0.0687	0.0241		0.0170
	(0.0431)	(0.0473)		(0.0178)
D.IMR	0.0149	0.0494		0.00360
	(0.0144)	(0.0430)		(0.00541)
Constant	-0.301***	-0.781***		-0.269***
	(0.0582)	(0.246)		(0.0472)
Obs	551	551		

Notes: Robust standard errors in parentheses. *p < 0:10, **p < 0:05, ***p < 0:01. ECT is the error correction term

4.3 Robustness checks

We carry out a number of robustness checks to test the consistency of our results. Firstly, we use alternative specifications to verify if our baseline results remain unchanged. Secondly, we ascertain if our results are robust to an alternative estimator. Finally, we verify if the linkage between these two variables depends on the income level of countries in our sample.

4.3.1 Alternative specifications

As earlier mentioned, we verify if our main results are robust to alternative specifications. For this exercise, we remove in different steps three explanatory variables from our baseline specification and results are shown in Table A1. Columns 1, 2 and 3 show estimates when we remove GDP, remittances and infant mortality rate respectively. Looking at the long run coefficient of FDI, we find that it is still positive and statistically significant. This confirms our result on the positive long run relationship between FDI and economic complexity in SSA.

4.3.2 An alternative estimator: System GMM

Our baseline results present a mixed linkage between FDI and economic complexity. These findings were obtained using a Pooled Mean Group (PMG) estimator. As earlier mentioned, the PMG might suffer from dynamic panel bias resulting from the fact that the lagged dependent term might be correlated with the fixed effects in the error term. In order to correct this, we employ a System GMM estimator. This estimator helps us capture robust results for the short run impact of FDI on economic complexity. Regression results obtained using the

SGMM are displayed in Table A2. Columns 1, 2 and 3 display regression results when using the OLS, FE and SGMM estimators respectively. We employ both the OLS and FE estimators to verify the validity of our results. The coefficient of the lagged dependent term of the SGMM estimates must lie between that of the OLS and FE estimators. In addition, we use the Arellano-Bond test for autocorrelation and Hansen test of over-identification to ensure the consistency of our SGMM estimates. Our regression results pass the specification tests as there is no evidence of second order serial correlation and the Hansen test confirms the validity of our instruments. Moreover, the coefficient of the lagged dependent term obtained from SGMM estimator (0.727) lies between that of the OLS (0,889) and FE (0.716). Based on the results displayed in column 3 (when using the SGMM), the coefficient of lagged ECI is positive and statistically significant at 1% level. This confirms the path dependence of SSA countries' economic complexity (Kamguia, et *al* 2022). Findings show a negative relationship between FDI and economic complexity. This result is similar to those obtained in the short run when using the PMG estimator. Hence, regression results when using the SGMM estimator confirm the short run negative linkage between FDI and economic complexity in the region.

4.3.3 The effect of economic development level

Our main results suggest that FDI positively affects economic complexity in the long run whilst a negative relationship is found between the two variables in the short run. We now ascertain if the linkage between these two variables depends on the level of income. We divide our sample into three sub-samples: low-income countries (LI), lower-middle income (LMI) countries and upper-middle (UMI) income countries according to the World Bank classification. The results are shown in Table A3 where columns 1, 2 and 3 display estimates of the UMI, LMI and LI respectively. The long run coefficients confirm a positive and significant impact of FDI on economic complexity in all three sub-samples. This suggests that regardless of the level of income in the long run, FDI has a positive and significant impact on economic complexity.

5. Conclusion

Economic complexity captures the level of sophistication of an economy's productive structure and it is a relatively new strand of development economics. Our study helps to understand the role of foreign capital on the structural transformation of SSA's economies. More Specifically, we focus on the linkage between FDI and economic complexity. This research contributes to the literature by investigating the inter-temporal effect of FDI on economic complexity. That is, we investigate both the long and short run impact of FDI on economic complexity. To do this we use a Pooled Mean Group (PMG) estimator with annual data for 21 SSA countries from 1980 to 2017. Our empirical results show a mixed impact of FDI on economic complexity depending on the temporary or permanent effects of FDI.

Our findings reveal that FDI promotes economic complexity in the long run whilst FDI negatively affects the complexity of products exported by SSA countries in the short run. The long run positive relationship might be explained by the fact that domestic enterprises take time to assimilate advanced foreign technologies. Conversely, the negative impact of FDI could be explained by the fact that foreign firms might oust domestic firms, hence producing a deleterious impact on the economies' level of complexity. Our result is robust to both an alternative estimator and specifications. Furthermore, the results show that in the long run, regardless the level of income, the relation between FDI and economic sophistication is positive.

From our findings, we suggest to SSA governments two main policy recommendations. First, SSA governments should invest in quality education to efficiently profit from the technological spillovers of FDI in order to enhance structural change and stimulate product sophistication of their economies. Second, we recommend that both SSA governments and stakeholders should put efforts in industrializing SSA economies. This will make SSA economies profit from the positive effects of FDI on economic complexity as domestic firms will be more competitive and less vulnerable to competition by foreign firms in the short run. However, there is no existing study which to the best of our knowledge investigates the non-linear impact of FDI on economic complexity. Therefore, future research should focus on investigating the transmission mechanisms through which FDI can affect economic complexity. More specifically, research could be carried out to investigate if financial level development, institutions and human capital, play a role on the impact of FDI on economic complexity.

Appendices

Table A1: Alternative specifications

VARIABLES	lnECI (1)	lnECI (2)	lnECI (3)
Long run coefficients	(GDP)	(Rem)	(IMR)
FDI	0.0143***	0.00972**	0.0135***
	(0.00187)	(0.00381)	(0.00227)
Corr	-0.0296**	-0.0530***	0.0174
	(0.0126)	(0.0131)	(0.0123)
GDP		-0.00112	-0.00693**
		(0.00262)	(0.00273)
Rem	-0.0192***		-0.00870**
	(0.00337)		(0.00366)
IMR	-0.00317***	-0.000993*	
	(0.000607)	(0.000522)	
ECT *(phi)*	-0.495***	-0.417***	-0.340***
	(0.0765)	(0.0500)	(0.0540)
Short run coefficients			
D.FDI	-0.00927*	-0.00340	-0.00676
	(0.00547)	(0.00237)	(0.00515)
D.Corr	0.0631	0.00864	0.0373
	(0.0410)	(0.0255)	(0.0255)
D.GDP		-0.000441	-0.00676
		(0.00121)	(0.00450)
D.Rem	-0.0279		0.482
	(0.139)		(0.427)
D.IMR	0.0119	-0.00650	
	(0.0147)	(0.0112)	
Constant	-0.318***	-0.349***	-0.330***
	(0.0579)	(0.0565)	(0.0607)

Notes: Robust standard errors in parentheses. *p < 0:10, **p < 0:05, ***p < 0:01. ECT is the error correction term

Table A2: Alternative estimator

	OLS	FE	SGMM
VARIABLES	lnECI (1)	lnECI (2)	lnECI (3)
L.lnECI	0.889***	0.716***	0.727***
	(0.0207)	(0.0292)	(0.0246)
FDI	-0.000214	0.000260	-0.00171***
	(0.00108)	(0.00128)	(0.000580)
Rem	0.00120	0.00320	-0.0117**
	(0.00214)	(0.00321)	(0.00554)
GDP	-0.00189	-0.00269*	0.00224
	(0.00130)	(0.00145)	(0.00207)
Corr	0.0195***	0.00678	0.00593
	(0.00654)	(0.00819)	(0.0150)
IMR	-0.000960***	-0.000119	-0.00240***
	(0.000278)	(0.000394)	(0.000658)
Constant	-0.0795***	-0.266***	-0.0815
	(0.0305)	(0.0429)	(0.0502)
Observations	573	573	573
AR (1)			0.001
AR (2)			0.258
Hansen			0.289

Notes: Robust standard errors in parentheses. *p < 0:10, **p < 0:05, ***p < 0:01.

Table A3: The effect of economic development level

VAR	UMI (1)	LMI (2)	LI (3)
Long run coefficients			
FDI	0.0451***	0.0145*	0.0256***
	(0.0158)	(0.00790)	(0.00263)
REM	0.170	0.0109	-0.0283***
	(0.148)	(0.00833)	(0.00575)
GDP	-0.00425	-0.0578*	-0.0649***
	(0.0385)	(0.0306)	(0.0221)
Corr	-0.00666	0.00512	-0.00859**
	(0.0108)	(0.00787)	(0.00351)
IMR	0.00131	-0.00119	-0.00456***
	(0.00467)	(0.00183)	(0.00102)
ECT *(phi)*	-0.642**	-0.343***	-0.498***
	(0.267)	(0.0498)	(0.121)
Short run coefficients			
D.FDI	-0.0280***	0.000759	-0.0101
	(0.00468)	(0.00630)	(0.0122)
D.REM	-1.244	0.195	-0.0262
	(1.141)	(0.126)	(0.0247)
D.GDP	0.00832	-0.00196	-0.00230
	(0.00635)	(0.00239)	(0.00333)
D.Corr	0.401	0.0614	0.0138
	(0.295)	(0.0547)	(0.0883)
D.IMR	0.155	0.0228	-0.0141
	(0.113)	(0.0247)	(0.0323)
Constant	-0.468***	-0.267***	-0.360***
	(0.178)	(0.0865)	(0.104)

Notes: Robust standard errors in parentheses. *p < 0:10, **p < 0:05, ***p < 0:01. ECT is the error correction term

Table A4: List of countries

Angola	Ghana	Nigeria
Cameroon	Guinea	Senegal
Congo, Dem. Rep.	Kenya	South Africa
Congo, Rep.	Madagascar	Tanzania
Cote d'Ivoire	Mauritania	Togo
Ethiopia	Mozambique	Zambia
Gabon	Namibia	Zimbabwe

Table A5: Definitions of variables and sources

Variables	Definitions	Sources
Economic complexity Index (ECI)	Measure the diversity and the ubiquity of a country's export structure, corrected for how difficult it is to export each product.	Atlas of economic complexity http://atlas.media.mit.edu
Foreign direct investment (FDI)	measured by net foreign direct investment inflows as a percentage of GDP	World Development Indicator (WDI)
Remittances (Rem)	Personal remittances, received (% of GDP)	World Development Indicator (WDI)
Gross Domestic Product (GDP)	is measured as the annual percentage growth rate of GDP per capita	World Development Indicator (WDI)
Corruption (Corr)	Corruption captures the level of corruption within the political system.	International Country Risk Guide (ICRG)
Infant mortality rate (IMR)	measured by the number of infants dying before reaching one year of age per 1,000 live births in a given year,	World Development Indicator (WDI)

References

Adegboye, F. B., Osabohien, R., Olokoyo, F. O., Matthew, O., & Adediran, O. (2020). Institutional quality, foreign direct investment, and economic development in sub-Saharan Africa. *Humanities and social sciences communications, 7(1), 1–9.*

Ahmad, A. H., Pentecost, E. J., & Stack, M. M. (2023). Foreign aid, debt interest repayments and Dutch disease effects in a real exchange rate model for African countries. *Economic Modelling*, 106434.

Amendolagine, V., Coniglio, N. D., & Seric, A. (2017). Foreign direct investment and structural change in Africa: Does origin of investors matter? *In Foreign capital flows and economic development in Africa (pp. 97–125). Springer.*

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of econometrics, 68(1), 29–51.*

Bin, X., & Jiangyong, L. (2009). Foreign direct investment, processing trade, and the sophistication of china's exports. *China Economic Review, 20(3), 425–439.*

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of econometrics, 87(1), 115–143.*

Breusch, T.S., & Pagan, A. R. (1980). The Lagrange multiplier test and its applications to model specification in econometrics. *Review of Economic Studies, 47(1), 239-253.*

Dinh, T. T. H., Vo, D. H., The Vo, A., & Nguyen, T. C. (2019). Foreign direct investment and economic growth in the short run and long run: Empirical evidence from developing countries. *Journal of Risk and Financial Management*, *12*(4), 176.

Eggoh, J., Bangake, C., & Semedo, G. (2019). Do remittances spur economic growth? evidence from developing countries. *The Journal of International Trade & Economic Development, 28(4), 391–418.*

Feulefack, L., & Ngassam, B. (2020). Natural resources, quality of institutions and foreign direct investment in Africa. *Economics Bulletin, 40(1), 148–162.*

Hidalgo, C. A., & Hausmann, R. (2009). The building blocks of economic complexity. *Proceedings of the national academy of sciences, 106(26), 10570–10575.*

Im, K. S., Pesaran, M. H., & Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of econometrics*, *115*(1), 53-74.

Kamguia, B., Tadadjeu, S., Miamo, C., & Njangang, H. (2022). Does foreign aid impede economic complexity in developing countries? *International Economics 169 (2022) 71-88.*

Kannen, P. (2019). Does foreign direct investment expand the capability set in the host economy? a sectoral analysis. *The World Economy, 43(2), 428–457.*

Khan, H., Khan, U., & Khan, M. A. (2020). Causal nexus between economic complexity and fdi: Empirical evidence from time series analysis. *The Chinese Economy, 53(5), 374–394.*

Maddala, G. S., & Wu, S. (1999). A comparative study of unit root tests with panel data and a new simple test. *Oxford Bulletin of Economics and statistics*, *61*(S1), 631-652.

Nickell, S. (1981). Biases in dynamic models with fixed effects. *Econometrica: Journal of the econometric society, 1417–1426.*

Nguéda, R. D. N., & Kelly A. M. (2022). The Nexus between Economic Complexity and Foreign Direct Investment in Sub-Saharan Africa. *South Asian Journal of Social Studies and Economics, 14 (2). pp. 41-52. ISSN 2581-821X.*

Osinubi, T. T., & Ajide, F. M. (2022). Foreign direct investment and economic complexity in emerging economies. *Economic Journal of Emerging Markets*, 245-256.

Payne, J. E., Truong, H. H. D., Chu, L. K., Doğan, B., & Ghosh, S. (2023). The effect of economic complexity and energy security on measures of energy efficiency: Evidence from panel quantile analysis. *Energy Policy*, *177*, 113547.

Pedroni, P. (1999). Critical values for cointegration tests in heterogeneous panels with multiple regressors. *Oxford Bulletin of Economics and Statistics 61: 653-670.*

Pedroni, P. (2004). Panel cointegration: Asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis. *Econometric Theory 20: 597-625.*

Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. *Journal of applied econometrics*, *22*(2), 265-312.

Pesaran, M. (2004). General diagnostic tests for cross section dependence in panels. *cambridge working papers in economics no. 435 and cesifo working paper series.*

Pesaran, M. H., & Smith, R. (1995). Estimating long-run relationships from dynamic heterogeneous panels. *Journal of econometrics, 68(1), 79–113.*

Pesaran, M. H., & Yamagata, T. (2008). Testing slope homogeneity in large panels. *Journal of econometrics, 142(1), 50–93.*

Pesaran, M. H., & Shin, Y. (1996). Cointegration and speed of convergence to equilibrium. *Journal of econometrics, 71(1-2), 117–143.*

Pesaran, M. H., Shin, Y., & Smith, R. P. (1999). Pooled mean group estimation of dynamic heterogeneous panels. *Journal of the American statistical Association, 94(446), 621–634.*

Saadi, M. (2020). Remittance inflows and export complexity: new evidence from developing and emerging countries. *The Journal of Development Studies, 56(12), 2266–2292.*

Schoors, K., & Van Der Tol, B. (2002). Foreign direct investment spillovers within and between sectors: Evidence from Hungarian data.

Sepehrdoust, H., Davarikish, R., & Setarehie, M. (2019). The knowledge-based products and economic complexity in developing countries. *Heliyon, 5(12), e02979.*

UNCTAD, W. (2020). World investment report 2020: International production beyond the pandemic. *United Nations New York and Geneva*.

Valette, J. (2018). Do migrants transfer productive knowledge back to their origin countries? *The Journal of Development Studies, 54(9), 1637–1656.*

Westerlund, J. (2007). Testing for error correction in panel data. *Oxford Bulletin of Economics and statistics, 69(6), 709–748.*

Yaprakli, S., & Ozden, E. (2021). The effect of sustainable development on economic complexity in OECD countries. RIMCIS : *Revista Internacional y Multidisciplinar en Ciencias Sociales, 10(2), 51–80.*