Economics Bulletin

Volume 45, Issue 3

Delving out of "Aid-Mirage Curse" in African Countries

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Abstract

Official Development Aid (ODA) can generate distortions in recipients' African countries, making the potential benefit turning into Aid ineffectiveness or Aid-Curse scenario. Delving into the intricate link between Economic complexity and ODA outcomes, this study innovates by exploring an efficient mechanism that can turn the Aid-mirage curse into a 'miracle' in a panel of 17 African countries. Using Ordinary Least Squares, Quantile Analysis and Two-Step System-Generalized Method of Moments, findings robustly established that interaction effect between ODA coupled good quality of institutions can enhance economic structural transformation, proxied by Economic complexity. Quality of institutions environment is a key factor for ODA effectiveness in Africa.

I am grateful to the Editor and the anonymous reviewers for their insightful comments and constructive suggestions, which greatly strengthened the overall manuscript. The usual disclaimer applies. I am also grateful to the 3 in 1 Team and AnalytiX International Lab.: Building African research's future is our challenge.
Citation: Jules-Eric Tchapchet-Tchouto, (2025) "Delving out of "Aid-Mirage Curse" in African Countries", *Economics Bulletin*, Volume 45, Issue 3, pages 1354-1364
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Submitted: February 20, 2025. **Published:** September 30, 2025.

1. Introduction

Despite the debate in the recent literature on its ineffectiveness (Kamguia et al., 2022; Avom et al., 2021; Sraieb, 2016) and weaknesses (Deaton, 2013; Asongu, 2012) among others, Official Development Assistance (ODA) is one of the most important mechanisms that donor international institutions and countries have conceived to alleviate poverty, improve welfare for millions of people and enhance economic development in recipient developing countries (UNCTAD, 2024). Conceptually, regarding its typology and adaptability, ODA is structured to enhance livelihoods, improve standard of living and stimulate sectoral structural transformation. Indeed, following OECD Data Explorer[1], foreign aid could be decomposed and applied in the following four dimensions where it potentially operates transformations in recipient developing countries: **first**, economic infrastructure and services such as energy, transports, communications, business and banking; **second**, production sector through agriculture-forestry & fishing, industry-mining & construction, tourism, trade policies and regulations; **third**, humanitarian within emergency response, reconstruction relief and rehabilitation, disaster prevention and preparedness; and multi-sector aid which usually operates in environmental protection, food-research-rural-urban related; and **four**, social infrastructure and services that support education, health, population policies, government and civil society, water and sanitation.

Unlike the previous pessimistic view, an optimistic view brought in the debate by studies led for example, by UN (2016) which posited that ODA's mechanism can increase human capital by enhancing health and lowering poverty. In the same vein, Galiani et al. (2017) supported that it can improve economic growth while Ridell and Nino-Zarazua (2016) posited the positive effect on education. Two main observations emerge from literature: **firstly**, considering growth and global competitiveness targets, the positive outcomes underlined above as well as the potential transformative dimensions of ODA have important implications: effective ODA generates economic structural change environment, features and incentives that are generally found in spaces characterized by progressive switch into knowledge-intensive structure and industries, rapid growth in output, income and employment, capacity to exploit productivity-increasing technological innovations, shift of the employment and resources from low productive sectors to modern services and industries that are highly productive sectors, and diversification trends. Production diversification capabilities provide an advantage in exports and competitiveness. **Secondly**, considering the improvement of well-being target, the positive outcome focusses on human capital and its ability to empower knowledge and human capabilities through increase of 'know-how', that are used to produce advanced technological goods (Hidalgo, 2023; Hartmann et al, 2017; Hausmann et al., 2014; Hausmann et al., 2007). Overwhelmingly, both considerations can be unified under the economic complexity, which is a measure of a country's ubiquity.

Absence of a consensus has characterized the ongoing debates referring to African economic performances and sustainable development, reachable through Sustainable Development Goals (SDG) 2030 such as inclusive growth challenge, quality of institutions improvements, access to energy alleviation among others. These debates can be summarized as follows: on the one hand, an important part of the literature has demonstrated that due to ineffective governance in African countries, there was no sufficient investment incentive for growth outcome. However, stronger quality of institutions enhances economic growth by acting as a catalyst for many factors (Asante et al., 2023) such as foreign aid (Mehlum et al., 2006). Particularly, ODA requires effective institutions as backbone of the economy (Martinez-Navarro et al., 2022) and as an efficient tool for boosting prosperity and mitigating poverty. On the other hand, a consensus seems to emerge in the recent literature and stylized facts, assessing that some African countries have experienced a rapid growth during the last decade. Indeed, based on real-statistics, while some of them also selected for the present study have been ranked among the fastest-growing

[1] See https://data-explorer.oecd.org

African countries, and listed among the twenty world's fastest-growing economies, projections from international credible organizations are expecting a certain number, to lead growth in the future (IMF, 2024). A special focus on these countries reveals that, while these countries have experienced an economic 'miracle', they have also improved their quality of institution as one of the main drivers of innovation.

Nevertheless, theoretical or empirical investigations of the effect of quality of institutions or ODA on economic complexity have always been discussed separately in the extant literature, whereas they are complementary factors that need to be implemented simultaneously for greater effectiveness. Therefore, the aim of this study is to fill this gap in the literature by contributing with an extensive investigation of the effect of a computed 'effective ODA' on economic complexity in Africa. This brings us to the following hypotheses that justify the ongoing research:
Hypothesis 1: Let's assume that ODA per capita and ODA received represented two ODA modalities in this study, that capture ODA flows transferred from donor countries to recipients' countries. **Under ineffective quality of institutions, ODA flows have a negative effect on the African countries' economic complexity**.
Hypothesis 2: Let's assume that effective ODA is captured through the interaction effect between both ODA modalities, and an aggregate quality of institutions factor. **Effective ODA has a positive effect on African countries economic complexity.**
Hypothesis 3: Let's assume that quality of institution can be divided into six components. Among them, **political stability, rules of law, and voice and accountancy are key individual components of quality of institutions that trigger economic complexity.**

This study relies on data taken from various sources: World Development Indicators (WDI), World Governance Indicators (WGI), the Massachusetts Institute of Technology Observatory of Economic Complexity (OEC) database, the Harvard's Growth Lab's Atlas, and various econometric estimation methods such as Ordinary Least Squares (OLS) used for benchmark tests. To check the robustness of the baseline results, alternative dependent variable, control variables and different specifications strategies were used: Driscoll & Kraay, Generalized Least Squares (GLS), Quantile Analysis and two-step System-Generalized Method of Moments (S-GMM). The two-step S-GMM strategy is used to address potential endogeneity, serial correlation and heteroskedasticity concerns for accurate empirical estimations and to ensure robust standard errors (Roodman, 2009a). For this test, lagged levels of the variables are used as instruments in the differenced equation and lagged differences of the variables as instruments in the level equation (Blundel & Bond, 1998).

The remainder of the paper is organized as follows: The section 2 presents the data, the econometric equations and the estimation strategies used for studying the effects 'monitored ODA' on economic complexity in African countries. While delving into baseline findings, section 3 deals with their implications, results interpretations, discussions, and sensitivity analyses. The last section concludes.

2. Data and methodology

2.1. Data

The association between ineffective and effective ODA flows and economic complexity in a panel of 17 African countries[2] is investigated with data spanning the period 2004 – 2019. The data used are obtained from three main sources as highlighted in Table 1 below. Economic Complexity Index (ECI) is extracted from the Massachusetts Institute of Technology (MIT) OEC repository. Economic Complexity Outlook Index (ECOI[3]) measures the connectedness of an economy's capabilities to drive easy diversification into related complex production relying on 'know-how',

[2] Botswana, Burkina Faso, Cameroon, Congo Democratic Republic, Egypt, Ghana, Ivory Coast, Kenya, Madagascar, Mali, Morocco, Niger, Rwanda, Senegal, Togo, Tunisia, Uganda.
[3] We present ECOI as staken from Atlas Glossary on https://atlas.cid.havard.edu/glossary.

using Product Space. A high (low) complexity means that a country has a large (few) products that are nearby (distance from) complex products. Macroeconomic data were extracted from the WDI while quality of institutions is obtained from the WGI – World Bank database.

In this study, ECI represented the dependent variable. ECOI is the alternative dependent variable used for robustness, whereas the primary explanatory variables for the first baseline test are ineffective ODA per capita and ODA received. For the second baseline test, an index of quality of institution (IQ_factor) is the arithmetical mean of the six components of quality of institutions popularized in the WGI – World Bank database. This Institutional quality factor is used to compute the explanatory variable of the second baseline test which is the effective ODA proxied by the interaction effect between ODA and that specified IQ factor where it is applied.

Table 1: Descriptive Statistics

VARIABLES	Sources	(1) N	(2) Min	(3) Max	(4) Mean	(5) Range	(6) SD	(7) Skewness	(8) Kurtosis
Dependent variable and alternative dependent variable									
ECI	OEC	272	-1.703	1.581	-0.646	-0.646	0.477	0.968	5.733
Independent variable: First baseline test									
ODA per capita	WDI	272	0.343	377.5	51.45	51.45	31.26	4.460	45.12
ODA Received	WDI	272	0.0920	152.1	30.26	30.26	28.52	1.699	6.243
Independent variable: Second baseline test									
ODA*IQ factor	Author's	272	-0.814	2.815	0.398	0.398	0.613	1.760	6.564
Control variables									
Nat. Res. Rents	WDI	272	0.321	28.57	7.904	7.904	5.586	1.531	5.789
Debt	WDI	272	0	34.27	8.154	8.154	7.382	0.958	3.248
Debt Service	WDI	272	0.232	8.283	1.984	1.984	1.612	1.512	5.063
Inflation	WDI	272	-3.233	29.51	5.309	5.309	5.195	1.243	5.020
Remittances	WDI	272	0	10.82	3.621	3.621	2.890	0.757	2.623
GDP Growth	WDI	272	-7.652	14.05	4.938	4.938	2.682	-0.638	5.716
Additional Control variables									
Institutional quality (IQ)	Author's	272	-1.719	0.718	-0.492	-0.492	0.485	-0.106	3.630
Corruption	WGI-WB	272	-1.546	1.160	-0.522	-0.522	0.582	0.856	3.440
Gov. Effectiveness	WGI-WB	272	-1.746	0.695	-0.532	-0.532	0.524	-0.101	2.990
Pol. Stability	WGI-WB	272	-2.388	0.736	-0.517	-0.517	0.670	-0.585	3.165
Reg. Equality	WGI-WB	272	-1.684	0.668	-0.392	-0.392	0.437	-0.374	3.681
Rules of law	WGI-WB	272	-1.786	0.696	-0.495	-0.495	0.527	-0.160	3.068
Voice & Acc.	WGI-WB	272	-1.697	0.736	-0.495	-0.495	0.591	0.0945	1.995

Source : Author's construction

Table 2: Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1) ODA receiv.	1.000															
(2) ODA pc	0.296	1.000														
(3) ECI	-0.322	0.005	1.000													
(4) IQ Index	-0.341	0.274	0.348	1.000												
(5) Res. Rent	0.377	-0.125	-0.371	-0.585	1.000											
(6) Inflation	0.111	-0.053	-0.002	0.017	0.200	1.000										
(7) Debt	-0.350	-0.088	0.377	0.291	-0.165	0.257	1.000									
(8) Remittances	-0.276	-0.044	0.267	0.020	-0.089	-0.135	0.045	1.000								
(9) GDP growth	0.213	0.127	-0.237	0.039	0.205	0.075	-0.171	-0.169	1.000							
(10) Debt service	-0.266	-0.023	0.272	0.048	-0.222	-0.114	0.289	0.234	-0.153	1.000						
(11) Corruption	-0.189	0.377	0.226	0.844	-0.469	-0.023	0.181	-0.025	0.089	0.095	1.000					
(12) Gov. Effect.	-0.345	0.236	0.379	0.889	-0.593	0.107	0.368	-0.066	0.046	0.218	0.824	1.000				
(13) Pol. stability	-0.325	0.146	0.282	0.870	-0.526	-0.055	0.217	0.071	0.016	-0.045	0.533	0.641	1.000			
(14) Reg. Equal.	-0.348	0.226	0.350	0.932	-0.592	0.054	0.285	-0.014	0.027	0.009	0.779	0.889	0.774	1.000		
(15) Rules of law	-0.358	0.258	0.409	0.937	-0.516	0.024	0.275	0.117	0.046	0.127	0.864	0.896	0.714	0.874	1.000	
(16) Voice Acc.	-0.239	0.205	0.209	0.791	-0.399	0.011	0.226	0.009	-0.014	-0.119	0.486	0.494	0.846	0.632	0.615	1.000

Source: Author's construction, IQ Index: Mean of Institutional Quality components. ODA: Official Development Assistance.

Studying African countries is justified, as many countries in the region are ranked among the top twenty growing countries in the world, meaning that they are experiencing significant pattern of economic structural change, and quality of institutions transformation. Meanwhile, foreign aid is used as a mechanism which is aimed at improving economic development and welfare and global ODA in the direction of developing countries, reached a high record in 2022 (UNCTAD, 2024). **Table 1** presents the descriptive statistics and **Table 2** the pairwise correlation matrix.

Control variables

Based on the extant literature, a set of control variables extracted from WDI database that are more likely to describe the economic structure of African countries is added. According to Hartmann et al. (2017), GDP growth positively affects economic complexity. Therefore, a positive sign is expected. Olaniyi and Odhiambo (2024) posited that natural resource rents that include its different components (oil, gas, forest and coal rents), are negatively correlated to economic complexity. The associated coefficient is expected to be negative. Njangang et al. (2024) and Ajide (2024) established that remittances drive economic complexity in Africa. The expected sign should be positive for remittances' coefficient. A positive sign is anticipated for debt, debt service and inflation. Overwhelmingly, this study suggests improvements in the quality of the institutions because corruption for example is qualified by Mauro (1995) to be a severe obstacle to investment, entrepreneurship and innovation.

2.2. Methodology

Econometric Equations

The first baseline test is based on Kamguia et al. (2022)'s contribution and it examines the association between economic complexity and our 'non-monitored' ODA related to the ***Hypothesis 1***, as shown in the following equation:

$$\boldsymbol{ECI_{i,t} = \alpha_0 + \alpha_1 ODA_{i,j,t} + \delta_k X_{k,t} + u_i + v_t + \varepsilon_{it}} \quad \textbf{(1)}$$

Where $j \in \begin{cases} per\ capita\ (ODA) \\ or \\ net\ received\ (ODA) \end{cases}$

The second baseline test - Eq (3) - below is drawn from the Eq (1), computed with Eq (2) and its examines the relationship between the economic complexity and the constructed variable $ODA\_IQ_{i,j,t}$ that reflects the interaction effect between ODA and quality of institution in accordance with the ***Hypothesis 2***:

$$\boldsymbol{ODA\_IQ_{i,j,t} = ODA_{i,j,t} * IQ\_Index_{i,t}} \quad \textbf{(2)}$$

$$\boldsymbol{ECI_{i,t} = \beta_0 + \beta_1 ODA\_IQ_{i,j,t} + \delta_{k'} X_{k',t} + u_{i'} + v_{t'} + \varepsilon_{it'}} \quad \textbf{(3)}$$

Where $j \in \begin{cases} per\ capita\ (ODA) \\ or \\ net\ received\ (ODA) \end{cases}$

In these equations, t is a time variable, $ECI_{i,t}$ is the economic complexity, $\boldsymbol{\alpha_0}$ and $\boldsymbol{\beta_0}$ are the scale parameters. $\boldsymbol{\alpha_1}$ is the coefficient of the official development assistance, whereas $\boldsymbol{\beta_1}$ is the estimate coefficient of the 'monitored ODA' which will be determined. $\boldsymbol{\delta_k}$ and $\boldsymbol{\delta_{k'}}$ are vectors of the coefficients of the control variables, while $X_{k,t}$ and $X_{k',t}$ are vectors of controls variables. v_t

and v_t, represent a time-specific effect, ε_{it} and ε_{it} the error terms. Finally, u_i and u_i, are unobserved country-specific effects.

Econometric methods

For baseline tests, OLS method is used to estimate the two main equations (1) and (3). As this strategy can generate biased results and additionally, it is not accounting for time-invariant country-specific factors, the resulting endogeneity is addressed with the two-step System-GMM following Arellano and Bover (1995) and Blundell and Bond (1998) identification strategies. This method is used with finite sample correction of Windmeijer (2005) that also accounts for cross sectional dependence (Asongu & Acha-Anyi, 2019; Baltagi, 2008) and decreases the over-identification. Moreover, reverse causality, measurements errors in developing countries' statistics, omitted variables bias may be sources of identified endogeneity also resolved by the two-step S-GMM. With this method, following Njangang et al. (2024), lagged endogenous level explanatory variables are instruments for first-difference regression and lagged endogenous difference explanatory variables are instruments for level regression.

The equation adapted from the work of Kamguia et al. (2022) or Lectard and Rougier (2018) and to be considered here is:

$\boldsymbol{ECI_{i,t}} = \beta_0 + \gamma_1 \boldsymbol{ECI_{i,t-1}} + \beta_1 ODA\_IQ_{it} + \delta_k X_{k,t} + v_t + \varepsilon_{it}$ where $\boldsymbol{ECI_{i,t-1}}$ is the lagged dependent variable, γ_1 is the estimated coefficient of the lagged dependent variable, and the other terms remain unchanged as in Eq (3).

To prevent cross sectional dependence, Driscoll-Kraay strategy is used while Generalized Least Squares account for heteroscedasticity. Prediction of the likelihood of future events that can occur around other quantiles or conditional mean values is examined with quantile[4] regression strategy following Koenker (2005), Koenker and Hallock (2001) as well as Koenker and Bassett (1978).

3. Results, robustness tests and discussion

3.1. Baseline results and implications

This section presents the regression results based on Eq (1) and Eq (3) elaborated for this study, as well as robustness check analyses. Table 3 shows the coefficient estimates from the first baseline test. Column (1a) evidenced that the relationship between economic complexity and our 'non-monitored' ODA represented by ODA received is negative and statistically significant at the 1% significance level. As per this result, a 1% increase of ODA leads to a 0.00538% decrease in African countries' diverse productive capabilities. In column (2), ODA per capita is not significant. Column (1b) displayed that when controlling quality of institutions with an aggregated quality of institution factor, its estimate coefficient is positive. With these prerequisites, as depicted in Fig. 1, the 'monitored ODA' described by the interaction between ODA flows and quality of institutions factor is positively associated with economic complexity. Concretely, an increase of each unit of standard deviation related to 'monitored ODA' computed with ODA received as shown in column (3) (ODA per capita – column 4) yields to 0.00556 (0.00510) increase in the African countries' knowledge based or sophisticated productive capabilities. Also known as economic resilience to external shocks capabilities, sophisticated productive capabilities relate improvement in economic

[4] The τ-th regression quantile $0<\tau<1$, is defined by Koenker and Basset (1978), as a solution to the minimization of the following problem: $min_\gamma \left\{ \sum_{i=Y_i \geq X_i'.\gamma} \tau |Y_i - X_i'.\gamma| + \sum_{i=Y_i < X_i'.\gamma} (1-\tau)|Y_i - X_i'.\gamma| \right\}$ given $Q(Y_i/X_i')$ the τ-th conditional expected value of the dependent variable given a covariate X_i' expressed as: $Q(Y_i/X_i') = X_i'.\gamma_\tau$.

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structural transformation. As presented in columns (5 – 6) for the first baseline test and (7 – 8) for the second baseline test, these results hold true across economic complexity outlook used as alternative measure of economic complexity. This result is contrary to that of Kamguia et al. (2022).

The positive association between 'monitored ODA' and African countries' economic structural transformation shed light on main policy implications for African countries, where ODA deployed with the support of effective governance can be used to strengthening economic development. Global policies can focus on educational and training programs aimed at enhancing inclusive quality of institutions for their leveraging effect to boost ODA flows, to enhance aid's effectiveness in well-being and economic prosperity targets, to protect investments in high-tech or high value-added industries that contribute to economic resilience in an increasingly competitive global economy.

Table 3: Baseline tests and sensitivity test with alternative dependent variable

VARIABLES	Dependent Variable: ECI					Alternative Dependent Variable: ECOI			
Estimations Tests	Baseline Test 1 (Benchmark)		Baseline Test 2 : Interaction Effect		Baseline 1 with QI mean Factor	Robustness Check 1 (for Baseline Test 1)		Robustness Check 2 (for Baseline Test 2)	
	(1a)	(2)	(3)	(4)	(1b)	(5)	(6)	(7)	(8)
ODA Received	-0,00538***				-0.00385***	-0.0108***			
	(0.000963)				(0.000989)	(0.00186)			
ODA per capita		7.63e-05					-0.00289*		
		(0.000928)					(0.00160)		
QI (Mean) Factor					0.265***				
					(0.0582)				
ODA rec. with Eff; QI (Mean) factor			0.00566***					0.00726***	
			(0.000807)					(0.00145)	
ODA pc with Effective QI factor				0.00510***					0.00227
				(0.000926)					(0.00162)
Constant	-0.483***	-0.649***	-0.535***	-0.537***	-0.399***	-0.0572	-0.199**	-0.211***	-0.296***
	(0.0400)	(0.0558)	(0.0310)	(0.0338)	(0.0428)	(0.0679)	(0.0933)	(0.0543)	(0.0594)
Observations	272	272	272	272	272	240	240	240	240
R-squared	0.104	0.100	0.154	0.101	0.168	0.124	0.014	0.096	0.008
F-Statistic	31.25	6.76	49.29	30.32	27.12	33.57	3.259	25.15	1.963

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Source: Authors' construction from Stata 18.5.

At this stage, we check for the robustness of our main findings that need to be strengthened. For this purpose, four strands of sensitivity analyses are performed: **Table 4** presents the results with additional control variables for attrition bias, Driscoll and Kraay and Generalized Least Squares, Fixed Effect, while **Table 5** diplays the estimations with quantile analysis and two-step System-GMM. This last test addresses the endogeneity concern.

3.2. Further sensitivity analysis: weighting 'monitored ODA' and covariates analysis

Verifying whether the positive association between 'monitored ODA' and economic complexity survives when additional control variables are added, revealing that the sign is confirmed and the result is significant at the 10% significance level (column 1 – Table 4) and 5% significance level (column 2 – Table 4) with both modalities of 'monitored ODA'. In Table 4, column (3) presents the result with alternative dependent variable. When removing the 'monitored ODA' variable (column 4), compared to the variation obtained in columns (1 & 2), 1% (1.5%) of the variance in economic complexity is due to 'monitored ODA' and not by other variables across time in African countries. The semi-partial correlation of 'Monitored ODA' is 1% if compared with column 1 (or 1.5% - comparison with column 2).

African economies, heavily reliant on natural resource rents exhibit negative association with economic complexity and corroborates Olaniyi and Odhiambo (2024)'s conclusion. Debt and remittances[5] significantly enhance economic complexity. Using ECI, although globally not significant, inflation's[6] estimated coefficient is positive while external debt is negative. The relationship revealed by GDP growth confirms the strong correlation between economic complexity and GDP growth (Hartmann et al., 2017). This negative and statistically significant estimated coefficient means that a decrease in economic growth will negatively affect the economic structural transformation capacities.

Table 4: Second strand of robustness check with control variables and other estimations strategies

VARIABLES	(1) ECI	(2) ECI	(3) ECOI	(4) SD	(5) ECI DK	(6) ECI GLS	(7) ECI FE
ODA Received & QI factor	0.00210*		0.00315*		0.00210**	0.00210**	0.000654
	(0.00108)		(0.00181)		(0.000897)	(0.00106)	(0.000888)
ODA per capita. & QI factor		0.00227**					
		(0.000943)					
Natural Resource Rents	-0.0163***	-0.0173***	-0.0172*	-0.0221***	-0.0163***	-0.0163***	-0.000936
	(0.00561)	(0.00513)	(0.00922)	(0.00236)	(0.00359)	(0.00552)	(0.00694)
Inflation	0.00362	0.00105	0.0544***	0.00280	0.00362	0.00362	0.00561
	(0.00513)	(0.00514)	(0.00823)	(0.00308)	(0.00310)	(0.00504)	(0.00470)
Debt	0.0158***	0.0158***	0.0107*	0.0180***	0.0158***	0.0158***	0.00936**
	(0.00386)	(0.00379)	(0.00612)	(0.00312)	(0.00236)	(0.00379)	(0.00391)
Remittances	0.0282***	0.0326***	0.0909***	0.0328***	0.0282***	0.0282***	0.000431
	(0.00908)	(0.00873)	(0.0139)	(0.00333)	(0.00290)	(0.00893)	(0.0144)
GDP Growth	-0.0190*	-0.0187*	-0.00877	-0.0193**	-0.0190**	-0.0190**	-0.0167**
	(0.00969)	(0.00965)	(0.0159)	(0.00781)	(0.00784)	(0.00953)	(0.00725)
Debt Service	0.0335*	0.0426**	0.127***	0.0387**	0.0335*	0.0335*	-0.00455
	(0.0198)	(0.0196)	(0.0306)	(0.0164)	(0.0174)	(0.0195)	(0.0227)
External Debt	-0.00102	-0.00221	-0.00215	-0.00255	-0.00102	-0.00102	-0.000839
	(0.00171)	(0.00152)	(0.00274)	(0.00185)	(0.00185)	(0.00169)	(0.00132)
Constant	-0.664***	-0.632***	-1.042***	-0.648***	-0.664***	-0.664***	-0.614***
	(0.0909)	(0.0905)	(0.143)	(0.0986)	(0.0942)	(0.0894)	(0.112)
Observations	272	272	240	272	272	272	272
R-squared	0.320	0.325	0.428	0.310	0.320		0.063
F-Statistic	15.46	15.84	21.58	88.61	81.39		
Number of ID	17	17	17	17	17	17	17
Wald chi2						127.9	

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1; Source: Authors' construction from Stata 18.5.

The computed indicator originally elaborated as an aggregated factor is modified and considering **Eq (2)** framework, ODA is now coupled with each component of quality of institutions as described in **Table 5**. The rationale behind this test is to estimate the marginal effect of deploying ODA flows while improving separately, each aspect of quality of institutions. As results, control of corruption coefficient is negative, and government effectiveness and regulatory quality are positive but not significant. Meanwhile, monitoring ODA with a particular focus to improve political stability, voice & accountability and rule of law leads to a positive and significant effect on economic complexity at the 1% (columns 3 and 6) and 10% (column 5) significance level.

Table 5: Third strand of Sensitivity analysis with alternative Quality of Institutions factors

	Dependent Variable: Economic Complexity Index					
VARIABLES	(1) Control of corruption improvement	(2) Government Effectiveness improvement	(3) Political Stability improvement	(4) Regulatory Equality improvement	(5) Rule of Law improvement	(6) Voice & Accountability improvement

[5] This result is corroborating the study of Njangang et al. (2021) and Ajide et al. (2024).
[6] However, it is positive and statistically significant with the alternative dependent variable.

ODA & QI: Control of corruption	-0.000192					
	(0.00107)					
ODA & QI: Gov. Effectiveness		0.000715				
		(0.00110)				
ODA & QI: Polical Stability			0.00207***			
			(0.000733)			
ODA & QI: Regulatory Equality				0.00179		
				(0.00112)		
ODA & QI: Rule of Law					0.00200*	
					(0.00102)	
ODA & QI: Voice & Accountability						0.00235***
						(0.000854)
Control Variables	YES	YES	YES	YES	YES	YES
Constant	-0.648***	-0.651***	-0.690***	-0.664***	-0.655***	-0.667***
	(0.0912)	(0.0912)	(0.0911)	(0.0913)	(0.0906)	(0.0902)
Observations	272	272	272	272	272	272
R-squared	0.310	0.311	0.330	0.317	0.320	0.330
F-Statistic	14.79	14.86	16.23	15.24	15.47	16.16

Notes: *** p<0.01, ** p<0.05, * p<0.1 indicate the significance levels respectively. Robust standard errors are reported in parentheses.
Source: Author computation from Stata 18.5.

3.3. Quantile Analysis and Endogeneity

Likewise, the non-parametric estimation method known as quantile analysis introduced by Koenker and Bassett (1978) is applied, and results are presented in **Table 6**. Except 60th quantile (column 7) and 80th (column 9) where the results are positive but not significant, all the other quantiles significantly confirm the baseline findings.

Table 6: Fourth strand of sensitivity test: Robustness check with Panel Quantile Regression and system-GMM

VARIABLES	(1) Quantile 10th	(2) Quantile 20th	(3) Quantile 25th	(4) Quantile 30th	(5) Quantile 40th	(6) Quantile 50th	(7) Quantile 60th	(8) Quantile 75th	(9) Quantile 80th	(10) Quantile 90th	(11) SGMM
Lag ECI											1.150***
											(0.274)
ODA pc & QI	0.003**	0.002**	0.002**	0.002***	0.002***	0.002**	0.002	0.002*	0.001	0.002**	0.0127*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.00721)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	-0.894***	-0.826***	-0.888***	-0.844***	-0.813***	-0.768***	-0.649***	-0.482***	-0.471***	-0.394***	0.198
	(0.123)	(0.094)	(0.086)	(0.066)	(0.069)	(0.092)	(0.123)	(0.118)	(0.094)	(0.088)	(0.211)
Observations	272	272	272	272	272	272	272	272	272	272	255
Number of id1											17
AR(1)											0.0102
AR(2)											0.463
Hansen OIR											0.359
Fisher											3940
Instruments											13

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1; In column 11, the estimation accounted for the lagged dependent variable. In this table, the coefficients are based on the two step System-GMM estimator, using Windmeijer (2005)'s with finite sample correction. The option collapse has been used to reduce the instruments proliferation according to Roodman (2009a, 2009b) and it also decreases the over-identification and accounts for cross-sectional dependence (Asongu & Acha-Anyi, 2018; Baltagi, 2008).

Column (11) presents the two-step system-GMM estimates. The diagnostic results revealed a persistent positive and statistically significant effect at the 1% significance level for economic complexity's lagged value, meaning that structural transformation, which reflects productive capabilities and diversification of countries' exports is an accumulative and dynamic, path-dependent process over time (Hausmann et al., 2007). The interest variable sign and significance confirms the baseline result. Furthermore, the exogeneity conditions for consistent estimates are verified by the set of instruments (Hansen, 1982), instrument proliferation is avoided by using the collapsing option recommended by Roodman (2009a, 2009b) such that the number of instruments

is less than the number of countries, higher Fisher[7] statistics indicate the overall validity of the estimates, and while the null hypothesis of no second-order serial correlation of the first difference is accepted regarding AR(1) statistic, that of first-order residual serial correlation of the first difference equation is rejected, based on AR(2) output. As partial conclusion, overwhelmingly, two-step system-GMM results are valid.

4. Conclusion

After identifying the ineffectiveness of ODA and the negative impact of 'non monitored' ODA on economic complexity in our first baseline scenario, this research innovates by empirically demonstrate how economic complexity relates to ODA in 17 specific African countries. Using OLS estimation methods with data spanning 2004 to 2019, our findings from our second baseline scenario reveal that 'monitored ODA' (interaction between foreign aid flows and an aggregated quality of institutions factor) significantly increases African countries' diverse and sophisticated productive capabilities. Furthermore, an in-depth investigation revealed that interaction between ODA and three main individual quality of institutions factors computed separately (political stability, rule of law and voice and accountancy) triggers economic complexity. Our findings are robust to alternative estimation methods: additional control variables for attrition bias, Driscoll and Kraay, Fixed Effects and two-step System-GMM in response to reverse causality or endogeneity concerns. In a context of aid flows pressure with the sudden dismantling of the USAID or decrease of contributions from donors, African recipient countries should prioritize deployment of aid in a context of governance improvements, especially political stability, rule of law, and parliament representation. Acknowledging that ODA is one of the most predictable sources of external financing for developing countries, especially during crises, its effectiveness in terms of improvement in people's well-being and economic development achievements should be permanently evaluated.

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[7] See for examples: Tchamyou and Asongu (2017) or Tchamyou et al. (2019).

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