Research Article ISSN 2770-2928

International Journal of Agriculture and Technology

Foreign Direct Investment and Agricultural Total Factor Productivity in Mali: A Single-Country Time Series Analysis (1990–2018)

Abdramane Tamboura and Diakalidia Kouyate*

Faculty of Economic Sciences and Management, Department of Economic, University of Social Sciences and Management of Bamako (USSGB) – Mali.

***Correspondence:**
Diakalidia Kouyate, Faculty of Economic Sciences and Management, Department of Economic, University of Social Sciences and Management of Bamako (USSGB) B.P. 2575, Bamako-Mali.

Received: 14 Mar 2025; **Accepted:** 25 Apr 2025; **Published:** 05 May 2025

Citation: Tamboura A, Kouyate D. Foreign Direct Investment and Agricultural Total Factor Productivity in Mali: A Single-Country Time Series Analysis (1990–2018). Int J Agriculture Technology. 2025; 5(1): 1-5.

ABSTRACT

Purpose: *This paper examines the impact of Foreign Direct Investment (FDI) and Agricultural Total Factor Productivity (AgTFP) in Mali from 1990 to 2018.*

Research Method: *The analysis uses the Phillips-Perron and Augmented Dickey-Fuller unit root tests, the Johansen Cointegration test, and the Vector Autoregressive (VAR) model for stability and normality assessment. A Vector Error Correction Model (VECM) is further utilized to explore both short- and long-term relationships.*

Findings: *The results indicate that FDI inflows contribute positively to agricultural development and poverty reduction in Mali. FDI, which accounted for 3.3% of GDP in 2021, plays a crucial role in improving agricultural productivity, enhancing infrastructure, and strengthening value chains. However, the adjustment rate coefficient suggests that Mali's agricultural sector operates below its potential, facing challenges such as inefficient resource allocation, inadequate technological adoption, suboptimal infrastructure, and policy deficiencies.*

Originality/Value: *The study highlights the necessity for Mali to implement strategic policies aimed at enhancing agricultural productivity. Recommendations include increasing investment in agricultural research and development, facilitating farmer access to credit and resources, strengthening extension services, promoting innovation, and encouraging sustainable agricultural practices. By accelerating the transition toward an optimal equilibrium, Mali can boost agricultural productivity, improve food security, enhance rural livelihoods, and foster overall economic growth.*

Keywords

Agricultural Total Factor Productivity, Foreign Direct Investment, Economic Development, Mali.

Introduction

Foreign Direct Investment (FDI) has been a pivotal driver of economic transformation in Mali, evolving from a restricted socialist framework (1960-1991) to a liberalized, market-oriented regime post-1991. Following structural reforms aimed at trade and investment liberalization, FDI inflows gradually expanded, particularly in mining and agriculture the latter being a cornerstone of Mali's economy, contributing 40% to GDP and employing a significant share of the population [1]. Despite this centrality, the nexus between FDI and agricultural total factor productivity (AgTFP) a critical measure of sectoral efficiency remains underexplored, creating a gap this study seeks to address.

Globally, FDI is recognized for its potential to catalyze agricultural development through technology transfer, infrastructure enhancement, and value-chain integration [2,3]. In Sub-Saharan

Africa, empirical evidence highlights FDI's dual role: while it fosters job creation, productivity gains, and poverty alleviation [4,5], its efficacy is often moderated by structural constraints such as institutional fragmentation and resource misallocation [6]. Mali mirrors this duality. UNCTAD data identify France, China, and the United States as primary FDI sources, with inflows constituting 3.3% of GDP in 2021, yet sectoral analyses remain sparse. Existing studies, such as Kone [7] and Jeppesen and Mainguy [8], predominantly link FDI to broad economic growth in Mali, neglecting its nuanced impact on agricultural productivity a lacuna this paper rectifies.

This study examines the short- and long-term dynamics between FDI and AgTFP in Mali from 1990 to 2018, using time-series econometric techniques, including Johansen cointegration, VAR, and VECM models. By integrating variables such as physical capital, human capital, trade openness, exchange rates, and inflation, the analysis extends beyond prior works focused solely on macroeconomic aggregates [9,10]. By bridging the gap between FDI and agricultural productivity in Mali, this study sought to contribute to broader debates on sustainable agricultural development in resource-dependent economies.

Literature Review

The relationship between Foreign Direct Investment (FDI) and agricultural development has generated extensive empirical debate, particularly in developing economies. While some studies underscore FDI's role in enhancing productivity and reducing poverty, others highlight its contingent benefits, shaped by institutional and structural contexts. For instance, Alnafissa et al. [11] demonstrated that Gulf Cooperation Council (GCC) FDI significantly boosted Sudan's agricultural exports through improved productivity, attributing this to technology spillovers and value-chain integration. Similarly, Edeh et al. [12] found FDI's short-term agricultural output gains in Nigeria using Dynamic Ordinary Least Squares (DOLS), emphasizing deregulation as a catalyst. These findings align with Alfaro's [2] broader assertion that FDI fosters growth in emerging markets through resource reallocation and knowledge diffusion.

Contrasting results, however, reveal the complexity of FDI's impact. In Nigeria, Ogbanje and Salami [13] identified long-term adverse effects of FDI and exchange rate volatility on agricultural productivity, suggesting that macroeconomic instability may dilute FDI's benefits. Similarly, Epaphra [6] and Epaphra and Mwakalasya [14] observed negligible or negative correlations between FDI and agricultural value-added in Tanzania, attributing this to weak institutional frameworks and misaligned investment priorities. Such disparities underscore the role of contextual factors such as governance quality and sectoral targeting in mediating FDI outcomes, a theme echoed in Iddrisu et al. [15]'s Ghanaian study, where FDI exhibited short-term gains but long-term inefficiencies due to infrastructural gaps.

Methodological diversity further complicates consensus. Kouassi et al. [16] employed Vector Autoregression (VAR) and cointegration techniques to analyze Ivory Coast's agricultural sector, revealing FDI's adverse long-term effects but positive short-term spillovers a dichotomy attributed to unsustainable investment cycles. Conversely, Chaudhary [5] and Sikandar et al. [3] utilized panel data analyses to affirm FDI's positive linkages with agricultural growth in India and developing nations, respectively, emphasizing technology transfer and employment creation. These methodological contrasts highlight the need for context-specific models, particularly in economies like Mali, where agriculture dominates GDP (40%) but remains understudied in FDI-agriculture nexus research [7,17].

Existing Mali-focused literature remains narrowly concentrated on FDI's macroeconomic implications, neglecting sectoral productivity. For example, Fofana et al. [10] applied ARDL bounds testing to establish FDI's growth linkages in Mali but omitted agricultural Total Factor Productivity (AgTFP). Similarly, Sacko [9] examined globalization's FDI impacts without disaggregating sectoral outcomes. This gap is critical, given Mali's reliance on agriculture for employment and food security. By integrating AgTFP a holistic efficiency metric encompassing capital, labor, and technology this study extends prior frameworks, offering nuanced insights into how FDI interacts with structural determinants like physical capital, trade openness, and human development in Mali's agrarian context.

Methodology and Data Description

This study uses a single-country time series analysis from 1990 to 2018, using AgTFP, FDI, Physical Capital (PK), Human Capital Development (HK), Trade Openness (TOP), Exchange Rate (RER), and Inflation (INF) as key variables. Data was sourced from the World Development Indicators, Our World in Data, International Financial Statistics (IFS), and USDA databases.

Econometric techniques include unit root tests (Phillips-Perron and Augmented Dickey-Fuller) to determine stationarity, the Johansen Cointegration test to assess long-term relationships, and the VAR model to analyze stability and normality. The VECM is applied to explore short- and long-run dynamics.

Results and Discussion

The unit root tests confirm that most variables are non-stationary at level I(0) but become stationary at first difference I(1) (Table 1). Cointegration analysis establishes long-term relationships among variables, justifying the application of the VECM.

Vector Autoregressive (VAR) and Cointegration Analyses

Subsequently, a Vector Autoregressive (VAR) model was estimated, with optimal lag length selected using the Schwarz Information Criterion (SIC). Diagnostic tests for serial correlation (LM test), normality (Jarque-Bera), and heteroscedasticity (White test) confirmed the model's robustness (Table 2). The absence of serial correlation (LM p-value = 0.87), normally distributed residuals (Jarque-Bera p-value = 0.60), and homoscedastic variance (White test p-value = 0.10) underscored the reliability of the VAR specification. Stability tests, illustrated in Figure 1,

further validated the model, as all inverse roots of the characteristic polynomial lay within the unit circle.

Table 1: Unit Root Tests (Level and First Difference).

Variable	Test	Level I (0)		First Difference I (1)	
		ADF Stat	PP Stat	ADF Stat	PP Stat
AgTFP	ADF	-4.65	---	**-9.06***	---
	PP	---	-4.67	---	**-16.12***
FDI	ADF	-0.75	---	**-9.58***	---
	PP	---	-1.73	---	**-15.07***
PK	ADF	-2.65	---	**-5.30***	---
	PP	---	-2.76	---	**-5.30***
HK	ADF	1.59	---	**-3.35***	---
	PP	---	1.24	---	**-3.35***
TOP	ADF	-5.27	---	**-5.45***	---
	PP	---	-6.23	---	**-22.96***
RER	ADF	-2.31	---	**-5.29***	---
	PP	---	-2.12	---	**-5.29***
INF	ADF	**-3.99***	---	**-6.42***	---
	PP	---	**-3.79***	---	**-15.15***

*Note: ADF = Augmented Dickey-Fuller; PP = Phillips-Perron. Critical values at 5% significance level. I(0) = Level; I(1) = First Difference. *p < 0.05 (stationarity at 5% significance). Specifications: Trend/intercept applied where appropriate.*

Table 2: Diagnostic Tests for VAR Model.

Test	Null Hypothesis	Statistic	p-value	Conclusion
LM Test	No serial correlation	0.03	**0.87**	No serial correlation
Jarque-Bera	Residuals are normally distributed	1.02	0.60	Normality not rejected
White Test	Homoscedasticity	5.01	0.10	Homoscedasticity

Note : LM = Lagrange Multiplier ; JB = Jarque-Bera.

Johansen Cointegration Test Results

The Johansen cointegration test (Table 3) identified two cointegrating equations under both Trace and Max-Eigen statistics at the 5% significance level, confirming a long-run equilibrium relationship among the variables. This finding aligns with studies such as Kouassi et al. [16], who similarly identified cointegration in FDI-agriculture linkages in Ivory Coast. The Trace statistic, deemed more robust in finite samples [18], was prioritized for interpreting long-run dynamics.

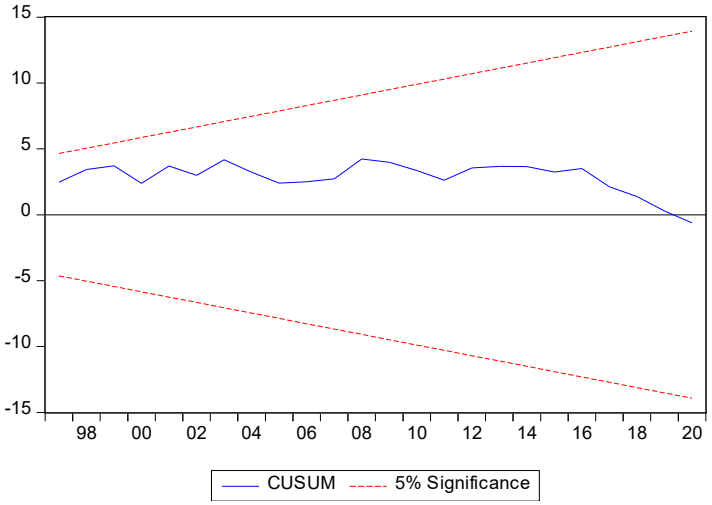
Table 3: Johansen Cointegration Test Results.

Hypothesized No. of CE(s)	Trace Statistic	Trace Critical Value	Max-Eigen Statistic	Max-Eigen Critical Value
None *	150.43*	111.78	52.38*	42.77
At most 1 *	98.05*	83.94	39.95*	36.63
At most 2	58.10	60.06	23.31	30.44
At most 3	34.79	40.17	16.33	24.16
At most 4	18.46	24.28	12.13	17.80
At most 5	6.33	12.32	5.82	11.22
At most 6	0.51	4.13	0.51	4.13

*Note: Trace and Max-Eigen statistics at 5% significance. *Rejects null hypothesis at 5% significance.*

Long-run VECM Results

A Vector Error Correction Model (VECM) was then estimated to disentangle short- and long-term effects. The normalized long-run coefficients (Table 4) revealed that FDI exerted a positive and statistically significant influence on AgTFP (β = 0.01, t-stat = 1.43). This implies that a $1 million increase in FDI inflows corresponds to a 0.01 unit rise in Mali's agricultural productivity. While modest, this effect mirrors findings in Pakistan [19] and Ghana [20], where FDI driven technology transfer enhanced agricultural output. However, the magnitude of FDI's impact in Mali remains constrained by structural bottlenecks, such as limited infrastructure and low human capital (HK), the latter of which showed an unexpectedly high coefficient (β = 0.49) but lacked statistical significance (t-stat = 189.84, likely due to data constraints). Trade openness (TOP) also positively influenced AgTFP (β = 0.07), underscoring the role of market integration in productivity gains.



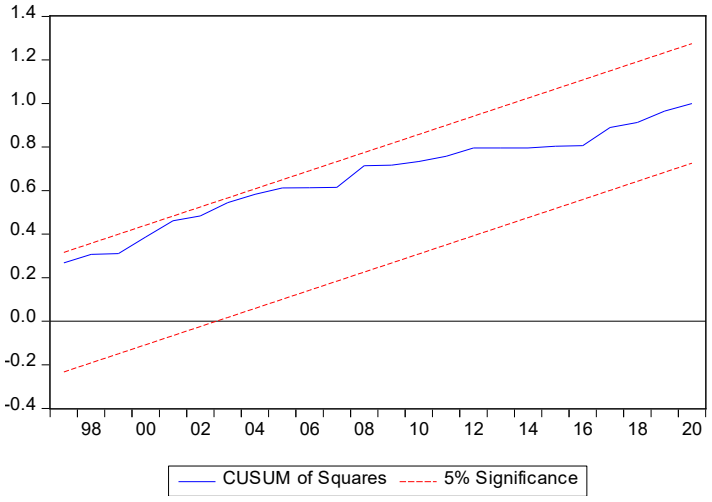


Figure 1: Agricultural Total Factor Productivity Model Stability Results.

Table 4: Long run Estimation for Agriculture Normalized.

The endogenous variable is AgTFP	
Exogenous variables	Coefficients
C	-2.44
FDI	0.01 (1.43)
PK	0.22 (0.94)
HK	0.49 (2.84)
TOP	0.07 (-0.51)
RER	0.59 (-0.12)
INF	0.48 (0.16)

FDI and AgTFP in the Agricultural Total Factor Productivity

In the short run (Table 5), the error correction term (ECT) for AgTFP was -0.03, indicating a 3% annual adjustment toward long-run equilibrium a sluggish convergence rate suggesting of institutional or structural rigidities. Short-term FDI inflows exhibited a negligible coefficient (β = 0.001), aligning with Iddrisu et al. [15]'s findings in Ghana, where FDI's benefits materialized primarily in the long term. Notably, physical capital (PK) and trade openness (TOP) drove short-term productivity (β = 0.77 and 0.68, respectively), highlighting the immediate gains from infrastructure investments and trade liberalization.

The dichotomy between FDI's long-run benefits and short-run inertia underscores systemic challenges in Mali's agricultural sector. Despite FDI's potential to spur productivity through technology diffusion, structural inadequacies such as fragmented land tenure systems, underdeveloped rural infrastructure, and limited access to credit impede its transformative impact. These findings resonate with Jeppesen and Mainguy [17], who cautioned that FDI's efficacy in Mali hinges on complementary institutional reforms.

Table 5: Speed adjustment and short run results.

Agriculture model	
Variable	**Coefficient**
AgTFP	0.03 (-0.16)
FDI	0.001 (-0.59)
PK	0.77 (-0.20)
HK	0.18 (1.23)
TOP	0.68 (95.94)
RER	0.13 (-0.53)
INF	0.30 (-0.03)

Conclusion

This study demonstrates the significant yet underutilized potential of FDI in enhancing Mali's agricultural productivity. While FDI inflows positively impact AgTFP, systemic inefficiencies, such as poor infrastructure and limited technology adoption, hinder optimal performance. Policymakers should focus on creating an enabling environment for FDI, emphasizing investments in agricultural technology, farmer training, and infrastructure. Future research should explore the distributional impacts of FDI to ensure inclusive growth, particularly for smallholder farmers.

References

1. World B. World Development Indicators 2021, Washington, DC: World Bank. 2021.
2. Alfaro L. Multinational activity in emerging markets: How and when does foreign direct investment promote growth?. Advances in Strategic Management. 2017; 36: 429-462.
3. Sikandar F, Vasilii E, Hongshu w, et al. The impact of foreign capital inflows on agriculture development and poverty reduction: Panel data analysis for developing countries. Sustainability. 2021; 13: 22.
4. Awunyo-Vitor D, Sackey R. Agricultural sector foreign direct investment and economic growth in Ghana. J. innov. entrepreneurship. 2018; 7:15.
5. Chaudhary A. Role of Foreign Direct Investment (FDI) in the growth of Indian agricultural sector: a post reform study. GJFM. 2016; 8: 119-129.
6. Epaphra M, Foreign direct investment and sectoral performance in Tanzania. Journal of Economics and Political Economy. 2016; 3: 670-719.
7. Kone D. An analysis on the Impact of Foreign Direct Investment (FDI) on Economic Growth of Underdeveloped African Countries: A case study on Mali. IOSR Journal of Humanities and Social Science. 2016; 21: 01-39.
8. Mainguy C, Jeppesen S. Is the Impact of FDI Similar in All Developing Countries? South Africa and Mali Compared?. In: E. Rugraff, D. Sánchez-Ancochea & A. Sumner, eds. Transnational Corporations and Development Policy: Critical Perspectives. London: Palgrave Macmillan. 2009: 176-201.
9. Sacko D, CHENG H. Impact of Social Globalization on the Economy and FDI of Mali. IJBSS. 2019: 10.
10. Fofana K, Xia E, Traore M. The causal linkage between foreign direct investment, trade and economic growth in Mali: an application of the ARDL bound testing approach. International Journal of e-Education, e-Business, e-Management and e-Learning. 2019; 9: 296-305.
11. Alnafissa, M, Mohammed A, Kamaleldin B, et al. Impact of Gulf Cooperation Countries' Foreign Direct Investment on Sudan's Agricultural Exports. Sustainability. 2022; 14: 3542.
12. Edeh C, Eze C, Ugwuanyi S. Impact of foreign direct investment on the agricultural sector in Nigeria (1981–2017). African development review. 2020; 32: 551-564.
13. Ogbanje E, Salami A. Impact of Foreign Direct Investment on Nigeria's Agricultural Sector (1981 to 2019). International Journal of Environment. Agriculture and Biotechnology. 2022; 7: 161-171.
14. Epaphra M, Mwakalasya A. Analysis of foreign direct investment, agricultural sector and economic growth in Tanzania. Modern Economy. 2017; 8: 111-140.
15. Iddrisu A, Immurana M, Halidu B. The impact of foreign direct investment (FDI) on the performance of the agricultural sector in Ghana. IJ-ARBSS. 2015; 5: 240-259.

16. Kouassi VD, Xu H, Pea-Assounga JBB. Impact of FDI on Agricultural Sector: Evidence from Ivory Coast. EJBM. 2021; 13: 34-40.
17. Jeppesen S, Mainguy C. Foreign Direct Investment in Africa. Searching for Impact in Mali and South Africa. Copenhagen, CBDS. 2007.
18. Lüutkepohl H, Saikkonen P, Trenkler C. Maximum eigenvalue versus trace tests for the cointegrating rank of a VAR process. The Econometrics Journal. 2001; 4: 287-310.
19. Abdullah S. Agriculture and Growth: Does Foreign Direct Investment Matters?. UCP Management Review. 2018; 2: 63-74.
20. Owutuamor Z, Arene C. The impact of foreign direct investment (FDI) on agricultural growth in Nigeria (1979-2014). RAAE. 2018; 21: 40-54.