Acta Universitatis Danubius
ŒCONOMICA

The Impact of Foreign Direct Investment and Information and Communication Technology on Lesotho's Economic Productivity

Ebenezer Megbowon[1], Zerihun Mulatu[2]

Abstract: Objective: To identify and investigate from a national perspective the variety of factors that could influence the achievement of Sustainable Development Goal with focus of goal 8.2 on economic productivity, the aim of this study is to empirically examine the impact of foreign direct investment and the development of information and communication technology on Lesotho's economic productivity. **Approach:** In this study, the stationary analysis is performed by using Phillips–Perron and Augmented Dickey–Fuller unit root tests, Johansen cointegration technique, and vector error correction method for short-run dynamics and causality relationship determination among the studied variables and their respective relative impact on economic productivity in the long-term period. Time series data for the period 1990 to 2021 was utilized to achieve the objectives of this study. **Results:** Results from the analysis suggest that FDI increases economic productivity in Lesotho, whereas ICT reduces. **Implication**: The result underscores the importance of creating an attractive investment climate and implementing policies to encourage foreign investors. It also suggests a need for re-evaluation of ICT investment strategies and policy interventions tailored to Lesotho's economic landscape. Addressing underlying structural issues or inefficiencies in ICT utilization may require targeted interventions such as enhancing digital literacy, improving technology infrastructure, or fostering a conducive business environment for ICT adoption.

Keywords: Foreign Direct Investment; Information and Computer Technology; Economic Productivity; Sustainable Development Goals; Lesotho

[1] PhD, Department of Economics, Tshwane University of Technology, South Africa, Address: Staatsartillerie Rd, Pretoria West, 0183, Pretoria, South Africa, Corresponding Author: megbowontoyin@gmail.com.
[2] Professor, Department of Economics, Tshwane University of Technology, Tshwane University of Technology, South Africa, Address: Staatsartillerie Rd, Pretoria West, 0183, Pretoria, South Africa, E-mail: ZerihunMF@tut.ac.za.

JEL Classification: G32; L96; J24; 010

1. Introduction

Overtime, one of the macroeconomic goals of governments of nations have been to transform the respective countries such that that sustained economic growth is achieved, improvement in human capabilities and standard of living by boosting people's self-esteem, freedom, and standard of living; in other words, development as defined by Todaro and Smith (2020), Ručinská et. al. (2016), and Soretz et. al. (2023), is achieved. Economic development fundamentally seeks to achieve more important social goals than merely boosting economic growth or economic expansion that is measured by the Gross Domestic Product (GDP) as posited by the traditional economics (Zuvekas, 1979; Todaro & Smith, 2020). Higher income levels, improved productivity, human development, more job opportunities, infrastructure development, technological advancement, and social equity are qualitative and quantitative components that are being aimed to be achieved during the process of economic development (Soretz, et. al, 2023; United Nations, 2020).

The global drive for development has led to the establishment of several development target over time, such as the 2030 Sustainable Development Goals (SDGs), which are thought to be attainable with international agreement, cooperation, and commitment (Klaniecki, et. al; 2019; Kanie, et. al, 2019). The SDGs are a series of seventeen (17) global objectives that were established by the United Nations (UN) in 2015 as part of the agenda for Sustainable Development to be realized by 2030. Hickmann, et. al. (2023) highlight that the SDGs are based upon the success and criticism of the Millennium Development Goals (MDGs). The SDGs provide a comprehensive framework to address the broad challenges that are related to health, economy, environment and social that is being faced by the global community today (UN, 2022). Each objective is interconnected and points to promoting sustainable development in its many dimensions. One of these goals is the goal 8 which is aimed at promoting full and productive employment, and decent work for all (UN, 2022).

Achieving full and productive employment is not only an economic goal but also a fundamental human right (Frey & MacNaughton, 2016; Frey, 2018). According to Olabiyi (2022) and González-Díaz, et. al. (2021), full, productive employment and decent job contributes to individual well-being, poverty reduction in all its forms, ensuring food security, economic growth, social stability, human capital development, reducing dependency, promoting gender equality, social progress, and sustainable development. According to the World Bank (year), an increasing trend is observed for global economic productivity of labour, where it increased from US$ 23,535 in 1990 to US$ 41,266 in 2021, a decline was recorded in the years 2009 and 2020 respectively. Comparatively, the average performance for the SSA region and

specifically Lesotho is low compared to the global average as shown in Figure 1. A low labour productivity indicates that, for every unit of labour input, workers are generating less output. This could be the result of a few things, including poor information, old technology, ineffective manufacturing methods, inadequate infrastructure, or insufficient expertise. Low labour productivity can impede economic growth by reducing the economy's potential for overall output and expansion. UN (2020) observed that the region's prospects for long-term economic development, including Lesotho, are not good given the region's declining labour productivity growth. UN (2020) further argued that many SSA nations will not make significant progress toward meeting the SDGs unless they implement robust policy measures to increase productivity. As a result, it becomes compelling that the governments and policy makers of the SSA countries, particularly Lesotho's, greatly increase labour productivity. Therefore, in agreement with Kim, et. al, (2021) and Twumasi, et. al. (2021), it is necessary to identify and investigate the variety of factors influencing labour productivity.

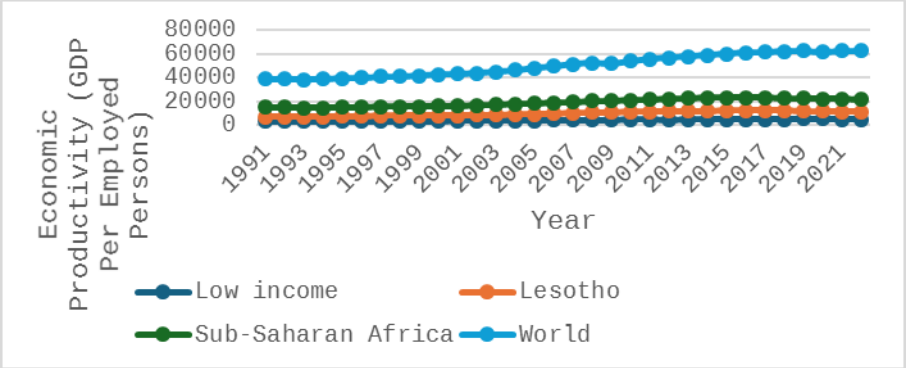

Figure 1. Trend in Economic Productivity

At the same time, a fast-paced transformations caused by globalization, technological progress, and changing economic paradigms and models are currently being experienced worldwide in the 21st century (Ayanponle, et. al, 2024; Rathore, et. al, 2024). Technological advancement with regards to ICT development is a critical component that has revolutionized communication, innovation, the way work is done, and significantly influence labour productivity (Amador & Silva, 2023; Daneshmand & Sattarifar, 2018; Laddha, et. al, 2022; Banday & Erdem, 2024). It includes digital tools that aid the capturing, gathering, processing, storing, and exchanging of information and data (Rouleau, et. al, 2015). The growth of ICT infrastructure, particularly internet and mobile-cellular subscription, can have a significant impact on economic productivity because it makes it easier to collaborate and communicate, allows for workforce mobility and flexibility, encourages e-commerce and digital business models, encourages innovation and entrepreneurship, boosts government efficiency, and supports data-driven decision-making (Kim, et.

al, 2021). As ICT development, deployment, and adoption continues to advance, its positive effects on economic productivity are expected to be further strengthened, contributing to sustained economic growth and development.

Equally, foreign direct investment (FDI) as a critical component of international economic relations, has the potential to significantly influence labour productivity (Dua & Garg, 2019; Nguyen, et. al. (2021). FDI is a category of cross-border investment that is associated with a resident (or an enterprise) in one economy having ownership, control, or a significant degree of influence on productive assets or the management of an enterprise that is resident in another economy (Lagendijk & Hendrikx, 2009; Meyer, 2015; IMF, 2003). Usually, foreign investor owns 10 percent or more of the ordinary shares and has objective of establishing a lasting interest in the FDI receiving country (IMF, 2003). It can be reliably deduced from the Figures 1 and 2 that the increase in the development of ICT and FDI in Lesotho may not have translated into proportionate advancements in labour productivity contrary to expectations, posing a perplexing challenge to policymakers, businesses, and economists alike. Therefore, this study aims to investigate if ICT development and FDI impact (or could be a driver of) economic development within the context of economic productivity of the Sustainable Development Goal (SDG) 8.2. Following the first section the other section of the study is structured as follows: brief review of theoretical and empirical literature is provided in section 2. Section 3 describes the methodology framework. The explanation of the study's findings is presented in section 4, while conclusion and policy recommendation are presented section 5.

2. General Organization of the Paper

Following the first section the other section of the study is structured as follows: brief review of theoretical and empirical literature is provided in section 2. Section 3 describes the methodology framework. The explanation of the study's findings is presented in section 4, while conclusion and policy recommendation are presented section 5.

3. Literature Review

This section first present theoretical framework that underpin the relationship between labour productivity and its determinants. Equally, the section presents a review of empirical literature on relation that exists between ICT, FDI, and labour productivity.

3.1. Theoretical Framework

From a theoretical viewpoint, impact of ICT and FDI on economic productivity is underpinned by the Neoclassical growth theory, Endogenous Growth theory and the New Growth model. In the neoclassical growth model initially developed by Robert Solow and where exogenous factors of growth are emphasized, economic growth primarily depends on capital accumulation, labour, and technological progress (Solow, 1956). FDI directly impacts economic growth through capital accumulation and the inclusion of new inputs and foreign technologies in the production function of the host country. FDI brings in capital, expertise, and technology, leading to increased productivity and output (Sinha, et. al, 2020). Equally, ICT plays a crucial role in the neoclassical framework. It enhances efficiency gains and knowledge dissemination through ICT tools that streamline processes, reduce transaction costs, and enhance efficiency, grant access to information to empowers workers and improves their skills. Also, ICT connects firms to global markets, enabling participation in international trade and attracting FDI.

Endogenous Growth Theory propounded by Romer (1986) and then extended by Lucas (1988), Romer (1990), and Barro (1990), on the other hand argued in favour of endogenous factors rather than exogenous factors as main drivers of growth (Diebolt & Perrin, 2014), stressing the importance of human capital, research and innovation, increasing returns to scale, and knowledge accumulation (Diebolt & Perrin, 2014). In this case, FDI contributes to endogenous growth through spillover effect of introduction of advanced technologies and managerial practices, which spills over to domestic firms, human capital development where multinational corporations invest in training and skill development, and innovation that comes through knowledge transfer. Equally, under this framework, ICT enhances education, training, and skill development, facilitates innovation and research, and enables new business models and startups, thus making it a key component of endogenous growth.

Likewise, the New Growth theory growth theory extended the Endogenous growth theory by focusing on the role of institutions, investments in technology and in human capital, knowledge spillovers, and increasing returns to scale in fostering economic growth. It emphasizes the importance of research and development (R&D) and knowledge creation. FDI is seen as a catalyst for innovation, knowledge spillovers, and productivity growth. Thus, enhancing the host country's absorptive capacity by exposing local firms to new technologies and management practices. Also, ICT is a central driver of the new growth model because ICT facilitates knowledge creation through information sharing, collaboration, and learning, and thereby fostering innovation and productivity. A robust ICT infrastructure supports economic growth. All these is conceptually presented in Figure 2.

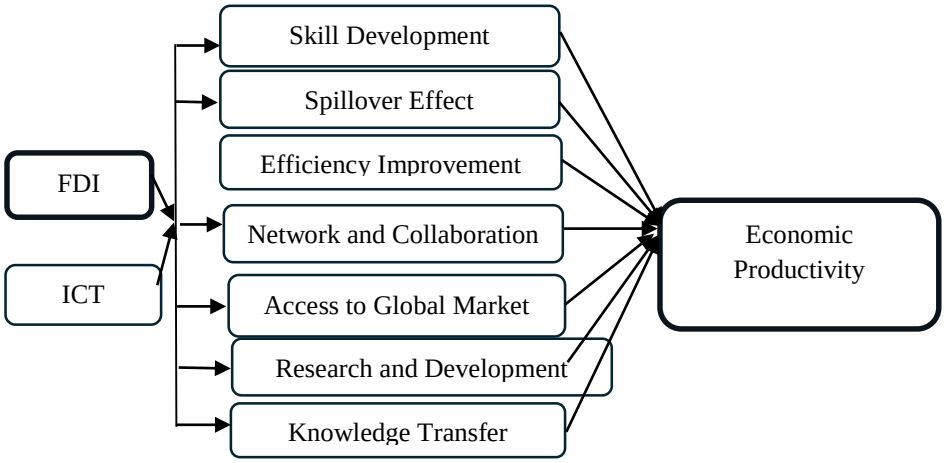

Figure 2. Conceptual Framework

3.2. Empirics

There has been a lot of empirical research done on the relationship between labour productivity, ICT advancement, and foreign direct investment. This section, which does not aim to be exhaustive, provides an overview of several recent studies and the variety of outcomes that can be linked to the studies' scope and application of empirical methodology.

3.2.1. FDI and Economic Productivity

Several studies have attempted to validate (or otherwise) the theory that underpins FDI-labour productivity relationship through empirical and econometric analysis. For example, Iheonu et. al. (2024) used the panel dynamic ordinary least squares (OLS) and the fully modified OLS on a study on selected 22 SSA countries to find that CFDI increase labour productivity significantly only in the long-run. Similarly, Vinh (2019) utilized Autoregressive Distributed Lag model on data from 1990 to 2017 for Vietnam to demonstrate that FDI has labour productivity-increasing possibilities. In related perspective, Dua and Garg (2019) used fully modified ordinary least squares on seven developed and developing economies in the Asia-Pacific region from 1980 to 2014 to establish that FDI has a positive and significant impact on labour productivity for developing countries, while its impact is insignificant for developed countries. Likewise, Nguyen et. al. (2021) on a study of 43 countries from 2002 to 2012 use the system-GMM estimation technique to find that inward FDIs increases income labour productivity especially if the host countries have a good institutional environment. A reducing effect of outward FDI flow is also established in the study. According to Asada (2020), FDI's influence on labour productivity is ambiguous in the shortrun period whereas it was found to contribute positively labour productivity in the long run. Nseera (2022) employed

the ARDL model of analysis using data from 1995 to 2019 to examine the determinants of labour productivity growth in Eritrea. The study confirms findings of other studies that FDI promote economic productivity growth. Also, Elmawazini et. al. (2018) engage the system GMM estimator technique on 14 transition economies during the period 2000–2012 to find insignificant positive impact of FDI on productivity growth. On a study of Macedonia for the period 2000 to 2016 Trpeski and Cvetanoska (2018) showed that foreign direct investment was important for Macedonian economic productivity. Following the utilization of various estimation techniques (Fully Modified Ordinary Least Square Method (FMOLS) and a panel quantile regression), Alam et. al. (2018) showed the impact of FDI on labour productivity to be positive and significant. Wamboye et. al. (2016) use the panel regression model (system GMM) on 43 SSA countries to find a significant positive impact of FDI on labour productivity. Lastly, in a study conducted among EU countries, where GMM panel estimator was used, it was shown that FDI indeed does have positive impact on economic productivity (Maciulyte-Sniukiene & Butkus, 2020).

3.2.2. ICT and Economic Productivity

One of the key elements raising labour productivity has been highlighted as the enhancement of processes brought about by ICT development. As a result, much scholarly research has examined how ICT affects labour productivity, much like the relationship between FDI and economic production. It can be observed that studies have been conducted at both firm (Tisdell, 2017; Amador & Silva, 2023; Lefophane & Kalaba, 2022) level and macro level (Daneshmand & Sattarifar, 2018; Relich, 2017; Wamboye, et. al, 2016; Laddha, et. al, 2022; Banday & Erdem, 2024; Salim, et. al, (2024); Hsieh & Goel 2019; Shahnazi, 2021), respectively.

Amador and Silva (2023) studied the influence of ICT on labour productivity in Portuguese companies and using technique that controlled for heterogeneity. It finds a significant positive effect of the adoption of ICT on labour productivity, with significant increases linked to online sales and the creation of websites. With the help of PMGs, Lefophane and Kalaba (2022) show that the impact of the intensity of ICT on labour productivity can be positive or negative, depending on the nature of industries, whether they are less intensive with ICTs or otherwise. Specifically, the study found that ICT has a positive and significant impact on the growth of economic productivity of labour in the more ICT-intensive firms, but a negative and significant impact on the less ICT-intensive groups in the long term. Relich (2017) and Wamboye et. al. (2016) demonstrated the positive and significant influence of ICT components on labour productivity in EU countries and SSA regions, respectively.

To investigate the impact of internet use on labour productivity growth, Daneshmand and Sattarifar (2018) used an upgraded Solow (1956) growth model, and the

autoregressive distributed lag (ARDL) bounds testing approach (Pesaran, et. al, 2001). The study concluded that internet use increases labour productivity over the long term. Likewise, Moyo et. al. (2024) confirmed that investments in ICT had a positive and significant influence on labour productivity in the primary and tertiary sectors only but had a negligible and negative effect in the secondary sector. In line with previous studies, Laddha et. al. (2022) evaluated the impact of ICTs on worker productivity by classifying a panel of 98 nations into three income groups (high-income, middle-income, and low-income) for the period 2000 and 2015. The significance of telephone and broadband subscriptions as factors influencing labour productivity positively was brought to light by their findings.

The role of ICT in labour productivity of OECD countries was empirically investigated by Banday and Erdem (2024) for the period 1996 to 2020. Employing quantile regression models to account for heterogeneous effects, the established a strong positive correlation between labour productivity and ICT use. Furthermore, heterogeneous effects are shown by the fact that the influence of ICT vary across different quantiles of the labour productivity distribution. In the same vein, Salim et. al. (2024) used panel estimation technique on Southeast Asian emerging economies to reveal that internet usage and mobile cellular subscriptions positively impact labour productivity. This finding supports the previous studies (Laddha, et. al, 2022; Lee, et. al, 2020). However, mobile broadband cellular is not statistically significant. Alam and Mamun (2017) suggest that the societies in the sample area benefit less from installing broadband. Using various panel estimation techniques Shahnazi (2021) analyzed ICT spillover effects on EU labour productivity (2007-2017) and find that ICT increase economic productivity. In the study of Hsieh and Goel (2019) on a panel of 28 OECD countries over a 16-year period, it was concluded that impact of internet usage on labour productivity is positive but insignificant. The existing literature highlights the potential benefits of ICT adoption and FDI inflows for economic productivity, but there is limited empirical evidence specific to Lesotho's context.

4. Methodology

4.1. Model Estimation

The main aim of this study is to investigate the impact of ICT development and FDI on economic productivity in Lesotho. In consistency with theoretical underpinnings and previous studies (Salim, et. al, 2024; Iheonu, et. al, 2024), the adapted explicit mathematical representation of relationship between the variables of interest with the inclusion of electricity consumption as a control variable is specified as follows.

$$EP_t=\alpha_0+\alpha_1 \ln ICT_t+\alpha_2 \ln FDI_t+\alpha_3 \ln EC_t+e_t \quad (1)$$

where, EP is economic productivity, ICT is information and communication technology, FDI is foreign direct investment and EC represents electricity consumption. α_0 is constant, α_(1-3) are parameters or coefficients to be estimated, e is the error term, t is time. The estimation techniques that are applied in this study include principal component analysis, Johansen Cointegration test, Vector Error-Correction Model (VECM) and Granger Causality test, respectively.

4.2. Data and Explanation of Variables

The data used in this study are annual time-series data, that cover the period from 1990 to 2021 for the Lesotho economy. The data set is obtained from the World Bank World Development Indicators website.

Labour Productivity is the dependent variable of interest. The variable is usually defined as output per hour worked or output per worker (Iheonu, et. al, 2024; Salim, et. al, 2024; UN 2020). In line with the SDG 8.2 target, it is measured by real GDP per employed person in this study. ICT: This second variable of interest in this study. In this study, ICT is proxy by a composite index formed from three ICT elements (internet access [individuals utilizing the internet as a percentage of the population], fixed-telephone subscriptions (per 100), and mobile cellular subscriptions (per 100) (David, 2019; Adeola & Evans, 2019). The index was generated through a Principal Component Analysis technique. Following empirical findings (Daneshmand & Sattarifar, 2018; Moyo, et. al, 2024; Laddha, et. al, 2022) reported in the literature review section, it is posited in this study that ICT will positively impact economic productivity. FDI stock: FDI stock is used a proxy for FDI in this study, because FDI stock as opposed to FDI flows, represents the entire amount of productive capacity possessed by foreign investors in the host country over time, hence its adoption in this study. Moreover, FDI stock inflow offers a more accurate estimation of the long-term behaviour of investment decisions (Camarero, et. al, 2018). In line with theoretical consideration and findings from previous studies (Iheonu, et. al, 2024; Vinh, 2019; Dua & Garg, 2019; Nguyen, et. al, 2021; Maciulyte-Sniukiene & Butkus, 2020), it is hypothesised in this study that the impact of FDI on economic productivity would be positive. Electricity Consumption: This variable refers to the total amount of electrical energy used by households, businesses, industries, and other entities over a specified period within a geographical location. It is an essential factor that influences economic activities. The variable was obtained from the Energy Information Agency (EIA) and measured in billion kilowatt-hours (kWh). A positive relationship is expected between electricity consumption and labour productivity in this study. This is so because increased electricity usage enables firms to operate more machinery, utilize advanced technology, or extend operational hours, leading to higher productivity levels.

4.3. Analytical Techniques

4.3.1. Unit Root Tests

Given the common occurrence of unit root behaviour in macroeconomic variables, it becomes essential to account for non-stationarity when analysing and modelling these variables. This is also necessary to prevent spurious regression estimate that arises from non-stationary variable modelling. Unit root testing is a statistical procedure that is often employed to determine the stationarity and order of integration of a series (Shrestha & Bhatta, 2018). A time series is said to have a unit root if it is nonstationary at level but became stationary after the first differencing-integrated of order one. The Augmented Dickey and Fuller (ADF) test (Dickey & Fuller, 1979) and the Phillips-Perron (PP) test (Phillips-Perron, 1988) are employed in this study to determine the order of integration of the series under consideration.

4.3.2. Cointegration Tests

Cointegration test is one of the tools used in econometric to understand relationship between timeseries macroeconomic variables. Cointegration which refers to the long-term equilibrium relationship between two or more time series variables, indicates whether there is a stable relationship between variables over time. To conduct a cointegration procedure it is required that series are nonstationary in their level form. Two or more non-stationary time series are said to be cointegrated if they possess the same integration order of I (1) and a linear combination of these time series is stationary I(0) (Johansen, 1995). If these variables are being cointegrated, then there exists a long-run relationship among these variables (Johansen, 1995). The study utilizes the Johansen cointegration techniques to achieve this purpose.

4.3.3. Causality Test

It is known that cointegration tests checks the existence of long-run relationship among the variables or otherwise, but it does not demonstrate the direction of the causal relationship. This study employs the VECM-based Granger causality test to examine the direction of causality between economic productivity, ICT and FDI. The VECM-based Granger causality test is suggested only if there is confirmation of the long-run relationship among the variables (Sinha & Shastri, 2023; Engle & Granger, 1987).

5. Results and Discussion

Table 1 provides descriptive statistics offering insights into key variables within Lesotho's economic and technological landscape. Firstly, focusing on Economic Productivity, the mean value of 5610 indicates the average level of productivity within the economy, with a standard deviation of 1280 suggesting a notable degree of variability around this mean. The coefficient of variation (c.v.) of 0.228 indicates a moderate level of relative variability in productivity levels compared to the mean. Turning to Foreign Direct Investment (FDI), the mean value of 524.2 represents the average amount of FDI inflows, with a standard deviation of 364.5 indicating considerable variability in these inflows. The coefficient of variation (c.v.) of 0.695 suggests a relatively high level of relative variability in FDI compared to the mean. In terms of electricity consumption, with a mean consumption of 0.488 units, it signifies the average level of electricity usage across various sectors and regions. The standard deviation of 0.258 units indicates a notable degree of variability around this mean, suggesting that consumption levels can vary considerably from the average, possibly influenced by factors such as industrial activity, population density, and economic growth. The coefficient of variation (c.v.) of 0.529 highlights a relatively high degree of variability relative to the mean consumption, underscoring the diverse nature of electricity usage patterns within the country. Lastly, examining the ICT Index, the mean value of 0.082 signifies the average level of technological advancement and integration within the economy. The standard deviation of 1.432 suggests substantial diversity in ICT adoption across sectors or regions. The high coefficient of variation (c.v.) of 17.46 indicates a significant level of relative variability in the ICT Index compared to the mean.

Table 1. Descriptive Statistics

Variable	Mean	Std. Dev.	c.v.	Max	Min
EP	5610	1280	0.228	7585	3478
FDI	524.2	364.5	0.695	1157	83.00
EC	0.488	0.258	0.529	0.900	0.200
ICT	0.082	1.432	17.46	2.700	-1.093

Note: EP is the economic productivity and EC is the Electricity consumption.

Table 2 summarizes the results of unit root tests conducted on economic productivity, FDI, electricity consumption, and ICT index to help determine the stationarity properties of each variable, which is crucial for understanding their long-term behaviour. For economic productivity, both the Augmented Dickey-Fuller (ADF) and Phillips-Perron tests indicate that economic productivity is integrated of order 1, denoted as I(1). This suggests that economic productivity exhibits a unit root at the level and becomes stationary after differencing once.

Table 2. Unit Root Test Results Summary

Variable	Term	ADF		Phillips-Perron		I(d)
		@level	@diff	@level	@diff	
EP	C	-1.463	-3.488**	-1.089	-3.412**	I(1)
	c + t	0.165	-3.714**	-0.593	-3.639**	I(1)
FDI	C	-0.669	-5.794***	-0.641	-6.791***	I(1)
	c + t	-1.763	-5.992***	-1.785	-6.854***	I(1)
EC	C	-0.956	-5.085***	-0.993	-5.085	I(1)
	c + t	-1.748	-5.003***	-1.917	-5.003	I(1)
ICT	C	-1.131	-5.345***	-1.099	-5.315***	I(1)
	c + t	-1.118	-5.427***	-1.211	-5.427***	I(1)

*** p < 1%, ** p < 5%, * p < 10%

The same integration order is observed for economic productivity when a time trend is included in the analysis. Similarly, FDI shows the same integration order of I(1) in both the level and trend models, indicating that FDI is also non-stationary at the level but becomes stationary after differencing once. The unit root tests for both the electricity consumption and ICT index reveal that they are integrated of order 1 (I(1)), both in the level and trend models. This implies that the electricity consumption and ICT index are non-stationary at the level but become stationary after differencing once. By implication, this result indicates that a Vector Error Correction (VEC) model is appropriate.

Table 3. Information Criteria Statistics For Optimal Lag

Lag	LR	AIC	SC	HQ
1	NA	-4.738*	-3.990*	-4.499*
2	10.13	-4.131	-2.637	-3.653
3	27.20*	-4.575	-2.334	-3.858

*Note: * denotes lag selected by criterion*

Table 3 provides information criteria statistics aimed at determining the optimal lag length for the VEC model. The absence of a Likelihood Ratio (LR) for the first lag is noted, suggesting a limitation in model comparison at this stage. However, subsequent lags reveal LR values indicating the likelihood ratio test statistic, which assesses the model's fit compared to a simpler version with fewer lagged variables. Moving to the Akaike Information Criterion (AIC), Schwarz Criterion (SC), and Hannan-Quinn Criterion (HQ), lower values across these metrics signify superior model fit, balancing goodness of fit with model complexity. Notably, for lag 1, all three criteria-AIC, SC, and HQ yield the lowest values, denoted by asterisks, suggesting lag 1 as the optimal choice. In this study, however, lag 2 (as the average lag between lag 1 and 3) is employed in the cointegration test and the estimation of the VEC model.

Table 4. Johansen Cointegration Test Summary

Data Trend	None	None	Linear	Linear	Quadratic
Test Type	No Intercept	Intercept	Intercept	Intercept	Intercept
	No Trend	No Trend	No Trend	Trend	Trend
Trace	2	1	2	1	1
Max-Eig	1	1	1	1	1

Note: Critical values based on 5% MacKinnon-Haug-Michelis (1999)

The outcomes of the Johansen tests are displayed in above Table 4, with a significance level set at 5%. The Johansen cointegration test involves assumptions about whether an intercept, a trend, or both are included in the cointegration space. In this approach, the key decision-making statistics are the Trace and Maximum-Eigen statistics. Generally, a full rank result suggests that a VAR model is appropriate, while a reduced rank case indicates a VEC model. A zero-rank test outcome suggests the estimation of a VAR model with a differenced variable. Despite variations in assumptions, the results consistently indicate at least 2 cointegrating vectors and at most 1 in the VEC model, thus supporting the rejection of the zero cointegration hypothesis. In other words, the result reveals that there is at most one cointegration vector among the variables.

Long-run and Short-run Adjustment Analysis

Equation 2 depicts the Johansen maximum likelihood estimated long-run coefficients. The result suggests that ICT exerts a significant negative influence on economic productivity. Specifically, the analysis reveals that with each unit increase in ICT development, there is a corresponding long-term decrease of 0.33% in economic productivity level. This result is inconsistent with the a priori expectation of this study, it is also not in consistent with some previous literature.

$$ect_{t-1} = [1.000lnEP_{t-1} - 0.380lnFDI_{t-1} - 0.396EC_{t-1} + 0.331ICT_{t-1}]$$

Std. Err.	[0.143]	[0.116]	[0.067]
p-value	p <0.01	p <0.01	p <0.01

(Salim, et. al, 2024; Laddha, et. al, 2022; Lee, et. al, 2020). From an economic standpoint, this finding carries several implications. Firstly, despite the prevailing belief in ICT's potential to drive productivity gains through improved efficiency and innovation, this study indicates a contrary effect within this specific setting. Such a revelation prompts a reevaluation of ICT investment strategies tailored to the unique economic landscape of Lesotho. Furthermore, understanding the negative impact of ICT on productivity can inform decision-making processes for businesses and policymakers. It may lead to a reassessment of resource allocation, potentially directing investments towards areas that have a more positive impact on productivity or exploring ways to mitigate the adverse effects of ICT. Additionally, the identified negative relationship between ICT and productivity could indicate underlying

structural issues within the economy or inefficiencies in the utilization of ICT resources. Addressing these issues may require targeted interventions, such as improving digital literacy, enhancing technology infrastructure, or fostering a more conducive business environment for ICT adoption.

Furthermore, the result reveals a noteworthy positive relationship between FDI and economic productivity in the Lesotho economy. In particular, the study shows that over the long term, a 0.38% rise in productivity is associated with each one percent increase in FDI. The result is clearly in consistent with the a priori expectation of this study and previous studies result (Dua & Garg, 2019; Nguyen, et. al, 2021; Iheonu, et. al, 2024; Trpeski & Cvetanoska, 2018; Maciulyte-Sniukiene & Butkus, 2020). This finding holds significant implications for Lesotho's economic development strategy. It underscores the potential benefits of attracting FDI to enhance productivity levels, stimulate economic growth, and foster innovation within the country. Additionally, it highlights the importance of creating an attractive investment climate and implementing policies that encourage foreign investors to allocate resources to Lesotho's economy.

Also, the result revealed a significant positive association between electricity consumption and productivity in Lesotho's economic context. It indicates that in the long run, higher electricity consumption is associated with a 0.39% boost in productivity levels. This finding holds considerable economic significance for Lesotho. It underscores the pivotal role of electricity as a fundamental input in various industries and sectors, such as manufacturing, mining, and services. Therefore, policies aimed at ensuring reliable electricity supply, improving infrastructure, and promoting energy efficiency are crucial for fostering productivity growth and economic development in Lesotho.

Moving to the short-run adjustment mechanism, an alpha coefficient of -0.089 that is statistically significant at 1 percent was estimated and obtained for the model of interested, suggesting that the long-run relationship contributes significantly to the short-run movement of economic productivity. In essence, it can be inferred from the alpha vector that about just 8.9% of economic production shortage (i.e., below the equilibrium level) is adjusted within a year. From an economic perspective, this insight carries significant implications, suggesting that while some corrective action occurs within a relatively short timeframe, the adjustment process is relatively slow and only addresses a fraction of the overall production shortfall. This could imply various factors affecting the efficiency of the adjustment mechanism, such as market dynamics, policy interventions, or structural constraints within the economy.

Table 6. A VECM-Based Granger Causality Test Result

Null Hypothesis (H0)	Chi-sq Stat.	df	*p-values*	*Decision*
FDI does not Granger cause EP	11.540***	2	0.003	Reject H0
EP does not Granger cause FDI	0.265	2	0.876	Failed to reject H0
EC does not Granger cause EP	1.419	2	0.492	Failed to reject H0
EP does not Granger cause EC	6.865**	2	0.032	Reject H0
ICT does not Granger cause EP	17.050***	2	0.000	Reject H0
EP does not Granger cause ICT	3.535	2	0.172	Failed to reject H0

**** p < 1%, ** p < 5%*

The results from Table 6 on a VECM-based Granger causality test, provide valuable insights into the causal relationships between economic productivity and the other three variables. First, focusing on the relationship between FDI and economic productivity, the test rejects the null hypothesis that FDI does not Granger cause economic productivity with a high level of significance. This suggests that FDI significantly influences economic productivity in Lesotho. Conversely, the test does not reject the null hypothesis that economic productivity does not Granger cause FDI, indicating a lack of evidence that economic productivity leads to changes in FDI levels. Moving on to the relationship between electricity consumption and economic productivity, the null hypothesis that electricity consumption does not Granger cause economic productivity is not rejected, with a chi-square statistic of 1.419 and a corresponding probability value of 0.492. This suggests that there is insufficient evidence to conclude that changes in electricity consumption directly cause changes in economic productivity. Conversely, the null hypothesis that economic productivity does not Granger cause electricity consumption is rejected with a high level of significance, as evidenced by a chi-square statistic of 6.865 and a probability value of 0.032. This indicates that changes in economic productivity does influence variations in electricity consumption within the Lesotho economic context. Finally, examining the relationship between ICT and economic productivity, the test rejects the null hypothesis that ICT does not Granger cause economic productivity with a high level of significance. This indicates that ICT significantly influences economic productivity in Lesotho. However, the test does not reject the null hypothesis that economic productivity does not Granger cause ICT.

6. Conclusion

Theoretically, both ICT development and FDI can play significant roles in fostering economic productivity, which is crucial for achieving Sustainable Development Goal (SDG) 8 on decent work, productive employment, and economic growth. In validating this proposition in the case of Lesotho, this study examined the

relationship between ICT development, FDI inflows and economic productivity in Lesotho by considering their causal relationships and the extent to which both macroeconomic factors contribute to economic productivity. First, a positive relationship and impact between FDI and economic productivity was established through the conducted analysis. Whereas a negative influence of ICT on economic productivity was found. The comprehensive relationship analysis within a multivariate framework of FDI and ICT in relation to economic productivity within the Lesotho economy offers significant implications for economic development strategies. The findings 1) highlight the potential benefits of attracting foreign investment to stimulate economic growth and foster innovation. This underscores the importance of creating an attractive investment climate and implementing policies to encourage foreign investors, 2) suggests a need for re-evaluation of ICT investment strategies and policy interventions tailored to Lesotho's economic landscape. Addressing underlying structural issues or inefficiencies in ICT utilization may require targeted interventions such as enhancing digital literacy, improving technology infrastructure, or fostering a conducive business environment for ICT adoption. Lastly, the positive association between electricity consumption and productivity emphasizes the critical role of reliable energy supply in driving productivity growth across various sectors.

References

Alam, M.S.; Miah, M.D.; Hammoudeh, S. & Tiwari, A.K. (2018). The nexus between access to electricity and labour productivity in developing countries. *Energy policy*, Vol. 122(1), pp. 715-726.

Amador, J. & Silva, C. (2023). *The impact of ICT adoption on productivity: Evidence from Portuguese firm-level data*. No. w202307.

Asada, H. (2020). Effects of foreign direct investment and trade on labor productivity growth in Vietnam. *Journal of Risk and Financial Management*, Vol. 13(9), 204.

Ayanponle, L.O.; Elufioye, O.A.; Asuzu, O.F.; Ndubuisi, N.L.; Awonuga, K.F. & Daraojimba, R.E. (2024). The future of work and human resources: A review of emerging trends and HR's evolving role. *International Journal of Science and Research Archive*, Vol. 11(2), pp. 113-124.

Banday, T.P. & Erdem, E. (2024). ICT and declining labor productivity in OECD. *SN Business & Economics*, Vol. 4(3), pp. 1-19.

Barro, R.J. (1990) Economic growth in a cross section of countries. *Q J Econ*, Vol. 106(2), pp. 407–443

Chiemeke, S.C. & Imafidor, O.M. (2020). An assessment of the impact of digital technology adoption on economic growth and labour productivity in Nigeria. *NETNOMICS: Economic Research and Electronic Networking*, Vol. 21(1), pp. 103-128.

Daneshmand, A. & Sattarifar, M. (2018). The Effect of Internet Use on Labor Productivity in. *Economics Research*, Vol. 18(68), pp. 75-98.

Dua, P. & Garg, N.K. (2019). Determinants of labour productivity: Comparison between developing and developed countries of Asia- Pacific. *Pacific Economic Review*, Vol. 24(5), pp. 686-704.

Edirisa, Nseera (2022) Determinants of Labor Productivity Growth in Eritrea. *African Development Bank Group*, pp. 1-39. https://www.afdb.org/en/documents/eritrea-determinants-labor-productivity-growth-eritrea.

Elmawazini, K.; Saleeby, E.G.; Ibn el Farouk, A. & Al-Naser, B. (2018). Tripartite decomposition of labor productivity growth, FDI and human development: evidence from transition economies. *Economic Change and Restructuring*, Vol. 51, pp. 153-171.

Frey, D.F. & MacNaughton, G. (2016). A human rights lens on full employment and decent work in the 2030 sustainable development agenda. *Sage Open*, Vol. 6(2).

Frey, D.F. (2018). Economic growth, full employment and decent work: The means and ends in SDG 8. In the *Sustainable Development Goals and Human Rights*, pp. 122-142. Routledge.

González-Díaz, R.R.; Acevedo-Duque, Á.; Salazar-Sepúlveda, G. & Castillo, D. (2021). Contributions of subjective well-being and good living to the contemporary development of the notion of sustainable human development. *Sustainability*, Vol. 13(6), 3298.

Hickmann, T.; Biermann, F.; Spinazzola, M.; Ballard, C.; Bogers, M.; Forestier, O. & Yunita, A. (2023). Success factors of global goal- setting for sustainable development: Learning from the Millennium Development Goals. *Sustainable Development,* Vol. 31(3), pp. 1214-1225.

Hsieh, E.W.T. & Goel, R.K. (2019). Internet use and labor productivity growth: Recent evidence from the US and other OECD countries. *NETNOMICS: Economic Research and Electronic Networking*, Vol. 20(2), pp. 195-210.

Iheonu, C.O.; Abia, B.; Okwoche, P. & Ifelunini, I.A. (2024). Is FDI from China Good for Labour Productivity in Sub-Saharan Africa? A Panel Cointegration. *Foreign Trade Review*, 00157325231214047.

International Monetary Fund (IMF) (2003). *Glossary of Foreign Direct Investment Terms*. https://www.imf.org/external/np/sta/di/glossary.pdf.

Kanie, N.; Griggs, D.; Young, O.; Waddell, S.; Shrivastava, P.; Haas, P.M. & Kőrösi, C. (2019). Rules to goals: emergence of new governance strategies for sustainable development. *Sustainability Science*, Vol. 14, pp. 1745-1749.

Kim, J.; Park, J.C. & Komarek, T. (2021). The impact of Mobile ICT on national productivity in developed and developing countries. *Information & Management*, Vol. 58(3).

Klaniecki, K.; Wuropulos, K. & Hager, C.P. (2019). Behavior Change for Sustainable Development. In *Encyclopedia of sustainability in Higher Education,* pp. 85-94. Cham: Springer International Publishing.

Laddha, Y.; Tiwari, A.; Kasperowicz, R.; Bilan, Y. & Streimikiene, D. (2022). Impact of Information Communication Technology on labor productivity: A panel and cross-sectional analysis. *Technology in Society*, Vol. 68.

Lefophane, M.H. & Kalaba, M. (2022). Estimating effects of ICT intensity on productivity, employment and output in South Africa: an industry-level analysis. *Information Technology for Development*, Vol. 28(2), pp. 346-371.

Lucas, R.E. (1988). On the mechanics of economic development. *J Monet Econ*, Vol. 22, pp. 3–42.

Maciulyte-Sniukiene, A. & Butkus, M. (2020). Impact of information and communication technologies on productivity growth. *International Journal of Information Technology and Management*, Vol. 19(1), pp. 1-18.

Moyo, C.; Mishi, S. & Ncwadi, R. (2024). The determinants of labour productivity in the Eastern Cape Province: A sectoral and industry analysis. *Development Southern Africa*, pp. 1-17.

Nguyen, C.P.; Nhi, N.A.; Schinckus, C. & Su, T.D. (2021). The influence of foreign direct investment on productivity: an institutional perspective. *Review of Development Finance*, Vol. 11(1), pp. 35-45.

Olabiyi, J.O. (2022). Decent Employment and Poverty Alleviation for Socio-Economic Development and Its Implications for the Well-Being of the Citizenry in South Africa. APSTRACT. *Applied Studies in Agribusiness and Commerce*, Vol. 16(2), pp. 79-86.

Rathore, M.P.K.; Mahesar, M.A. & Rathore, M.H. (2024). Pakistan and Global Economy. *Al-NASR*, pp. 79-98.

Relich, M. (2017). The impact of ICT on Labor Productivity in the EU. *Information Technology For Development*, Vol. 23(4), pp. 706-722.

Romer, P. (1986). Increasing returns and long-run growth. *J Polit Econ*, Vol. 94, pp. 1002–1037.

Romer, P. (1990). Endogenous technological change. *J Polit Econ*, Vol. 98, S71–S102.

Rouleau, G.; Gagnon, M.P. & Côté, J. (2015). Impacts of information and communication technologies on nursing care: an overview of systematic reviews (protocol). *Systematic Reviews*, Vol. 4, pp. 1-8.

Ručinská, S.; Müller, R. & Nauerth, J.A. (2016). *Economic Development*. In: Marciano, A., Ramello, G. (eds). *Encyclopedia of Law and Economics*. Springer, New York, NY.

Salim, A.; Wen, J.; Bello, A.U.; Lubis, F.R.A.; Khoirudin, R.; Khasanah, U. & Nasir, M.S. (2024). Does information and communication technology improve labor productivity? Recent evidence from the Southeast Asian emerging economies. *Growth and Change*, Vol. 55(1), e12708.

Shahnazi, R. (2021). Do information and communications technology spillovers affect labor productivity? *Structural Change and Economic Dynam*ics, Vol. 59, pp. 342-359.

Sinha, M.; Das, R. & Sengupta, P.P. (2020). FDI, ICT and Economic Growth in Developing Countries: An Empirical Analysis. Role of IT-ITES in Economic Development of Asia. *Issues of Growth, Sustainability and Governance*, pp. 121-130.

Sinha, N. & Shastri, S. (2023). Does financial development matter for domestic investment? Empirical evidence from India. *South Asian Journal of Business Studies*, Vol. 12(1), pp. 104-126.

Solow, R.M. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics*, Vol. 70(1), pp. 65-94.

Soretz, S. Nodehi, M. & Taghvaee, V.M. (2023). *Sustainability and sustainable development concepts: Defining the perspectives and pillars*.

Tisdell, C. (2017). Information technology's impacts on productivity and welfare: a review. *International Journal of Social Economics*, Vol. 44(3), pp. 400-413.

Trpeski, P. & Cvetanoska, M. (2018). An empirical investigation of selected factors determining the labour productivity in Macedonia. *KNOWLEDGE-International Journal*, Vol. 28(1), pp. 89-95.

Vinh, N.T. (2019). The impact of foreign direct investment, human capital on labour productivity in Vietnam. *International Journal of Economics and Finance*, Vol. 11(5), p. 97.

Wamboye, E.; Adekola, A. & Sergi, B. (2016). ICTs and labour productivity growth in sub- Saharan Africa. *International Labour Review*, Vol. 155(2), pp. 231-252.

Zuvekas, C. (1979). Economic Growth and Economic Development. In: *Economic Development*. Palgrave, London.