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Analyzing how ease of business affects FDI using advanced models

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ABSTRACT

The primary aim of this research is to examine the effect of Investment Facilitation on the Ease of Doing Business and its subsequent influence on Foreign Direct Investment (FDI) inflow decisions. Using SPSS-AMOS regression applications, the impact of Investment Facilitation on Ease of Doing Business indicators was determined. For prediction, Machine Learning techniques, ARIMA in R and Python were employed. Our findings suggest that the ease of doing business rating positively impacts FDI inflow decisions, especially when combined with high investment facilitation. However, the ease of doing business ratings alone might not be sufficient to lure investors, especially in contexts like Nigeria or certain Sub-Saharan African countries. Interestingly, traditional forecasting with ARIMA on R projected a decline in FDI inflow over the next decade, whereas the Python model anticipated an increase. This research highlights the value of integrating quality investment facilitation services with favorable business ratings. Furthermore, while machine learning techniques offer refined forecasts, traditional models provide contrasting insights, accentuating the need for a multifaceted approach in predicting FDI inflow decisions. These insights are crucial for policymakers and stakeholders aiming to bolster investment attractiveness in regions like Sub-Saharan Africa.

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1. Introduction

UNCTAD reported that global FDI increased from under $5 billion in the early 1990s to $1.4 trillion in the 2000s, with developed economies peaking in 2007. After a 2007 drop, FDI surpassed $2 trillion in 2015. However, COVID-19 in 2020 caused a 35% global decline to $1 trillion. Developed economies saw a 58% drop, while developing ones, boosted by Asia, dropped only 8%, raising their global FDI share to two-thirds ((UNCTAD, 2019b, 2022)UNCTAD. Foreign Direct Investment (FDI) positively affects the countries where it is received as it boosts the productivity of companies and connects local businesses to worldwide markets. This has been proven by the quick growth of Asian economies that have recently become industrialized. However, this beneficial impact has not been fully taken advantage of in Africa. African countries have low levels of both FDI and participation in the global value chain (Qiang, 2021). In Nigeria, FDI fluctuated from 14.8% in 2012 to -4.7% in 2016. In 2020, it was 0.6% of GDP (down from 0.9% in 2019) due to COVID-19 disrupting global investments. (Bank, 2023). A recent report evaluated data from 2016/2017, highlighting improvements in FDI, noteworthy were Malawi, Zambia, Nigeria, and Djibouti (categorized as Middle East/North Africa), making significant improvements across three or more indicators. Notably, these nations achieved substantial enhancements in credit accessibility, reflecting progress in their investment climates

(Miller, 2018). Nigeria's Ease of Doing Business ranking improved from 146 to 131 in the World Bank's 2020 report, with a significant 11.45% progress.

Notably, Nigeria was one of the ten most improved economies, driven by reforms by the Presidential Enabling Business Environment Council (PEBEC). Major advancements were seen in construction permits (14.6%) and cross-border trade (6.1%) (Brc, 2019).

The OECD indicates that Investment promotion services like market info, and feasibility studies are critical services at IPAs and are resources, and are the complementary bodies for government that use a focused approach, targeting investors, and providing aftercare (Services, 2002; Unctad, 2002). Countries compete for FDI as corporations seek favorable conditions. FDI is vital for growth, leading governments worldwide, including developing nations, to actively attract investments (Unctad, 2002). This paper's primary objectives are to employ advanced model applications for empirical research, delve into how Investment Facilitation influences the Ease of Doing Business, and enrich the management science domain with insights into FDI inflow decisions, based on our drawn inferences and forecasting results. Thus, the study seeks to answer these questions: *1) How and to what extent do direct and the moderated effect of the Ease of Doing Business decision factor impact the FDI inflow decisions? And 2) To what extent does the moderated effect predict FDI inflow decisions?*

Our primary focus is to develop brief descriptive and more detailed predictive analytics that could potentially guide key stakeholders to understand the significance of interactive dynamics better and how the dynamics of investors' decision-making would shape IPA's investment attraction strategies. The research will apply the data obtained from an online survey on various individual investors using the Qualtrics survey tool.

Our study is related to those empirical studies that have attempted to determine the relationship between service quality and satisfaction (Ting, 2004) and that of Fullerton & Taylor on mediating and interactive effects in service quality and satisfaction(Gordon Fullerton, 2009). The few recent studies that engaged the doing-business statistics were more descriptive in their approach. Thus, their findings cannot be generalized and considered intensive to aid policy formulation on key economic relationships (Nketiah-Amponsah & Sarpong, 2020). The study analyzes ease of business and investment facilitation effects on SSA FDI using quantitative methods. Introduces a new FDI model for effective policies, challenging existing research by exploring regulatory, normative, and cognitive institutions (Dirk De Clercq, 2010). To date, crucial gaps in research exist regarding the influence of government policies on investment facilitation and ease-of-doing-business interaction in regulating agencies' impact on FDI performance during economic challenges. Additionally, there is a lack of information on how these moderated effects affect individual decision-making regarding FDI. We are i*nterested in this problem* because of the utmost importance of how FDI decisions generate employment, enhance personal safety, create wealth, and alleviate poverty.

Len's (2004) empirical study suggests that the institutional approach is predominant in FDI decision-making. This finding supports previous research on FDI. It indicates that managers should pursue FDI in environments with little institutional distance between the home and host countries(Treviño, 2004). However, a discovery by Henrik (2006) suggests that FDI has an impact on GDP via knowledge transfers and the adoption of new technology (Henrik Hansen, 2006). The World Bank study found that higher ease of doing business scores tend to increase FDI inflows, with a one-point increase associated with a 0.3 to 0.5 percentage point rise in FDI/GDP ratio (Bank.org, 2020).

A study by Bevan and Estrin (2004) found that countries with favorable business climates (as measured by the World Bank's Doing Business indicators) are more likely to receive FDI inflows. The study focused on 25 transition economies (Bevan & Estrin, 2004). Another study by Mohammed (2018) that investigated the impact of Ease of Doing Business on Inward FDI found that ease of business indicators' Enforcing Contracts' was found to have a significant positive impact on Inward FDI (Mohamed Tareq Hossain, 2018). Another study suggests that by increasing the country's Doing business rank by one level, a government can bring a substantial amount of FDI into a country. Thus, the model has proven that there is a connection between government actions and foreign direct investment (Piwonski & Bryant, 2010).

A study by Globerman in 2013 on Investment Facilitation and the Attractiveness of Developing Countries for FDI examined the effects of investment facilitation measures, such as streamlining administrative procedures and providing a conducive business environment, on FDI inflows in developing countries. He finds that investment facilitation positively impacts FDI inflows (Subasat & Bellos, 2013). Ke Xia's (2020) research reveals that investment facilitation in Africa significantly boosts China's investments

there. Specific factors like IT use, financial services efficiency, and institutional quality contribute notably to China's investments in the region (Xia & Devadason, 2020). Investment facilitation is government policies to attract foreign investment, while ease of doing business assesses business regulations. Research, like Kusuma's 2020 study, found no moderation of risk's impact on Foreign Direct Investment by the ease of doing business ratings across countries (Aisjah, Kusuma, & Siti, 2020).

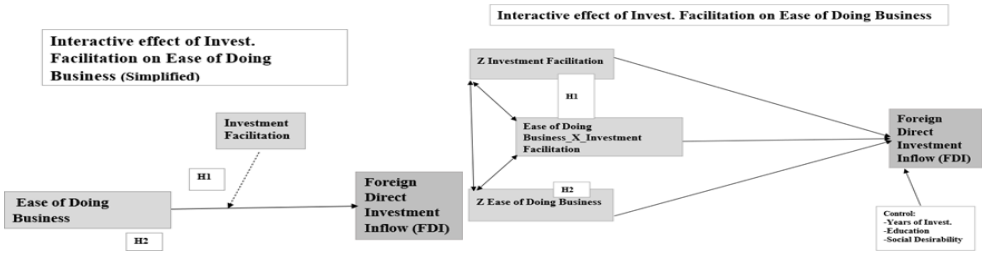
Zhang and Daly (2011) find investment facilitation boosts business ease in countries with high regulatory quality. It simplifies the investment process, World Bank research confirms its positive impact (Bank, 2020). Investment facilitation boosts ease of doing business and attracts FDI in politically stable nations, as per IMF research, business ease, especially in well-developed economies. Their study suggests sophisticated economies with transparent regulations benefit most from such policies (Imf, 2019; Zhang & Daly, 2011).

According to research by the United Nations Conference on Trade and Development, investment facilitation can aid in attracting foreign direct investment in significant economies, particularly within the manufacturing industry (UNCTAD, 2020) Ease of doing business impact on FDI is influenced by governance quality. Asiedu and Lien (2011) report stronger ease-of-business effects on FDI in countries with better governance (Asiedu & Lien, 2011). Investment facilitation eases business for investors by simplifying procedures, cutting costs, and offering information. Choqun (2021) underscores its role in fast-tracking investment development. (Chaoqun Niu, 2023) and that there are significant differences in the level of investment facilitation among regions. In addition to these studies, the World Bank's Ease of Doing Business Index (The World Bank, 2020) has shown that countries with good performance in the investment facilitation indicator index have better overall ease of doing business, however, not all a moderating effect on the relationship works between certain variables (Ana Paula, 2020),, thus, we posit that: *Hypothesis H1; Investment facilitation strengthens the positive relationship between the Ease of Doing Business and Foreign Direct Investment (FDI). Ease of Doing Business (EODB) has a stronger positive effect on FDI Inflow when Investment facilitation is higher. Hypothesis H2; Ease of Doing Business (EODB) has a positive effect on FDI Inflow*.

This research fills existing gaps by exploring how investment facilitation and ease of doing business interact to impact FDI inflows, particularly during economic challenges. Previous studies often focused more on descriptive analysis, lacking in-depth exploration of these interactive dynamics and their effects on individual decision-making regarding FDI.

2. Research Method

The data was analyzed using 'IBM SPSS Statistics' and 'IBM SPSS AMOS computer software (Sabirzyanov, 2017) We studied how investment facilitation interacts with ease of doing business in affecting FDI. We then predict FDI using ARIMA in R and AI in Python, combining both methods for accurate forecasting. These techniques aid economic development and decision-making by predicting FDI flows, utilizing historical patterns and interactive effects. The research model is depicted in Figures 1a and 1b.



Figures 1. Research model
Source: *Author*

Description of the design: The empirical study is a multi-level exploratory sequential method research with a design that begins by first analyzing the quantitative data and then building the subsequent models to validate the Analysis and make predictions (Creswell & Creswell, 2018). The analysis focuses on assessing the moderated effect of combined services on investors' FDI perception and predicting FDI decisions, considering ease of doing business ratings' impact over the next decade.

Source data for Descriptive Analysis: Original data sourced from online Survey Monkey and Qualtrics. Collected from FDI stakeholders in Sub-Saharan Africa and diaspora with Nigerian investments (2006-2018). Sampling, collection, procedures, constructs, and measures detailed in prior empirical studies (Yusuf, 2020) Z scores were calculated for Investment Facilitation, Ease of Doing Business, and their interaction in SPSS v28. Interacted variable mean 0.42%, st. dev. 36.48%; FDI inflow mean 67.08%, st.dev. 31.60%. Table 1 shows variations in FDI inflow classes due to moderated effects.

Table 1. Descriptive statistics

Descriptive Statistics	N	Minimum	Maximum	Sum	Mean		Std. Deviation
	Obs	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
ZEaseOfDoingBus	250	-3.2767	1.6328	0	0	0.0632	1
ZInvestFacilitation	250	-5.4821	2.0177	0	0	0.0632	1
EaseOfDoingBus_X_InvestFacil	250	-11.75	7.5	10.44	0.0418	0.2307	3.6481
FDIInflow	250	1	13	1677	6.708	0.1998	3.1595
Valid N (listwise)	250						

Source: *Author*

The correlation matrix indicates a low correlation between Z-scores for ease of doing business and interacting variables. Investment facilitation and interacted variables have a correlation coefficient of 0.332. The affected effect is not heavily influenced by investment facilitation for average FDI inflow decisions. The result does not impact the robustness of empirical estimates' validity, as standard errors for moderated effect remain strong in FDI inflow decision tests.

Control: Control variables were added in SEM using SPSS-AMOS to study their impact on the relationship between two independent moderated variables and FDI inflow. These variables enhance estimate accuracy and control social desirability bias (Sarah & Daniel, 2019).

Model Fit and Validity Tests: The model fit is good: CMIN/DF ratio is acceptable (2.0301), CFI is high (0.9965), SRMR is low (0.0458), and RMSEA is within limits (0.0643). However, the non-significant P-value and low P-Close hint at possible model fit improvement (MacKenzie, Podsakoff, & Podsakoff, 2011).

Validity and Reliability Analysis: Discriminant validity is confirmed for ZEaseOfDoingBus and EaseOfDoingBus_X_InvestFacil based on AVE. ZEaseOfDoingBus also shows discriminant validity via AVE < MSV. Yet, convergent validity for ZEaseOfDoingBus is not fully established (AVE < 0.50) as shown in Table 1. Both ZEaseOfDoingBus and EaseOfDoingBus_X_InvestFacil have moderate reliability (CR < 0.70) as depicted in Table. These concerns might be overlooked due to moderated variable effects (Gaskin, 2017).

Table 2. Validity and reliability - ease of doing business

	CR	AVE	MSV	MaxR(H)	ZEaseOfDoingBus	EaseOfDoingBus_X_InvestFacil
ZEaseOfDoingBus	0.491	0.491	0.958	0.491	0.701	
EaseOfDoingBus_X_InvestFacil	0.673	0.673	0.958	0.673	0.979	0.820

Source: *Author*

Source data for Predictive Analysis: We used the exact data for predictive Analysis. Still, this time we had to apply monthly data as "DatetimeIndex" for data modeling in Python, and of course, we used the same in R.

Correlations: Investment Facilitation and EODB: A positive correlation exists between investment facilitation services and ease of doing business. Investment facilitation involves aiding investors through the investment process. Ease of doing business pertains to a business-friendly regulatory environment's simplicity and predictability. There is a higher correlation between ZEase of doing business and the interacted variable far more than that of ZInvestment facilitation in the percentages of 98% and 38%, respectively.

Forecasting FDI Inflow Decisions with ARIMA in R:

Time Series Stationarity: the ability of statistical time series analysis tools, namely autoregressive integrative moving average (ARIMA) models, to forecast the future (Bri-Mathias, 2011). We first transformed the dataset into a time series object and then plotted the time series for stationarity, as shown in Figure 2.

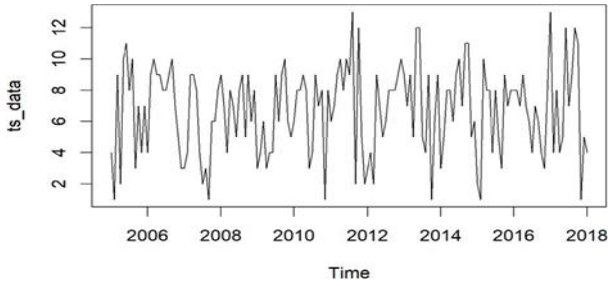
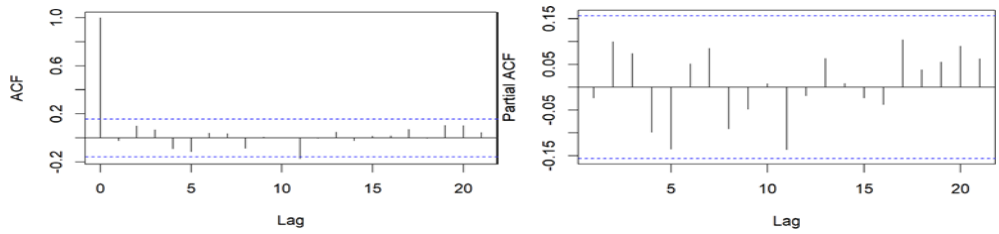


Figure 2. Stationarity
Source: *Data Processed with R, 2023*

We now conducted an Augmented Dickey-Fuller Test; the result indicates a significant P-value as; Dickey- Fuller = -5.4549, Lag order = 5, p-value =0.01. The alternative hypothesis suggests a stationary dataset, as shown in Figures 4a and b, respectively. To achieve a viable choice of the best model, we used ARIMA (2,0,1) (1,0,0) [12] with a non-zero mean of 775.1769. We checked to determine if it was stationary to fit the ARIMA model. The ACF of the residuals indicates no significant autocorrelations. We now know the data is stationary and controlled after conversion, as depicted in Figures 3a and b. We now checked the partial A correlation function and determined it is in order.



Figures 3. a and b ACF and PACF
Source*: Data Processed with R, 2023*

Forecasting FDI Inflow Decisions with ARIMA on Python: Python is used with libraries like pandas, NumPy, matplotlib.pyplot, and stats models for accurate time series forecasting of FDI inflow using 250 data points, including predictors "Z Investment_Facilitation" and "Z Ease of Doing Business". We now averaged the monthly value for each FDI inflow and used the start of each month as the timestamp, then plotted. The data type is float64, and the mean "MS" is the frequency depicted in Figure 4.

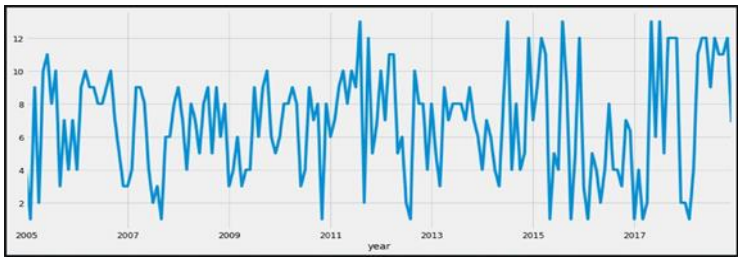


Figure 4. Averaged monthly values
Source: *Data Processed with ARIMA, 2023*

Time-series decomposition splits time series into Trend, Seasonality, and Noise. The "stats models" library is used for this. The "Additive" model was chosen, and the frequency parameter specifies time series frequency for visualization, as shown in Figure 6. Grid Search was used for optimal parameter selection, yielding ARIMA, the model diagnostics (Sharma Pawan, Dwivedi, Ali, & Arora, 2018) (1, 1, 1) x (1, 1, 1, 12)12 with AIC 845.272. Model fit details are shown in Table 6. AR parameter significant ($P < 0.05$); MA parameter not significant ($P > 0.05$); Seasonal AR parameter significant ($P < 0.05$). The sigma2 parameter's high p-value and wide confidence interval indicate insignificance. Coefficients' significance may vary based on model context and assumptions. We now run the model to investigate any unusual behavior and plot the diagnostics. Model diagnostics show near-normal distribution of residuals, though not perfect. Residuals, the difference between predicted and actual values, lack complete randomness but show patterns. The model captures important data aspects, except for irregularities in 2013, 2015, and 2018. One outlier was detected but deemed insignificant as indicated in Figure 5.

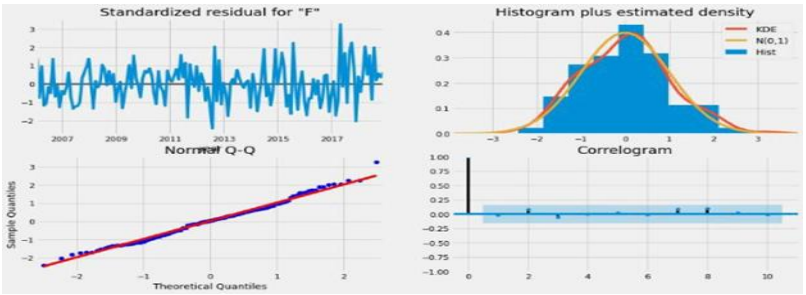


Figure 5. Diagnostics – doing of doing business
Source: *Data Processed with ARIMA, 2023*

Autocorrelation analysis indicates no significant autocorrelation; current and previous values are weakly correlated and will not affect future value estimates.

Validating Forecasts: To help us understand the accuracy of our forecasts, we compare the predicted FDI Inflow to the real FDI Inflow of the time series. We set projections from 2018–01–01 to the end of the data. We now Visualize the forecast as illustrated in Figure 6.

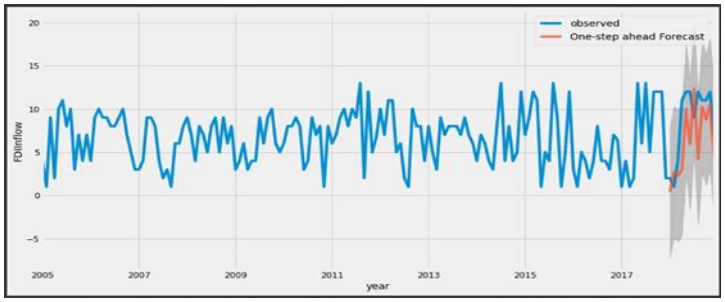


Figure 6: Forecast visualization.
Source: *Data Processed with Python, 2023*

The line plot shows the observed values compared to the rolling forecast predictions. Overall, our forecasts align with the actual values very well, showing a downward trend that starts from the beginning of the year 2018 and captures seasonality toward the end of the year.

3. Results And Discussions

Structural Equation Model: The same dataset as in "3.2" confirms the hypothesis: higher investment facilitation strengthens ease of doing business impact on FDI inflow decisions. Significant p-value (0.0081), and beta estimate (- 0.7134) align with Asiedu's findings on the ease of doing business moderated effect on FDI inflow (Asiedu & Lien, 2011). However, it depends on the business regulatory efficiency that is interrelated with other country attributes reflecting efficiency, sophistication, and quality, as Vogiatzoglou (2016) found in his studies on Ease of Doing Business and FDI Inflows in ASEAN (Vogiatzoglou, 2016). The second hypothesis is supported by an insignificant p-value of 0.0268 but with a robust beta estimate of 1.5432. This result did not contradict the findings mentioned in the literature review by Mohammed (2018) that ease of doing business indicators and enforcing contracts significantly positively impacted Inward FDI (Mohamed Tareq Hossain, 2018). All those are depicted in Table 3 and Figure 7, extracted from SPSS-AMOS output.

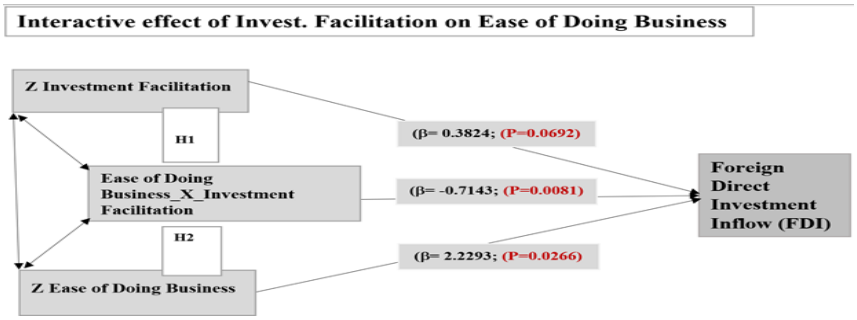


Figure 7. Model results
Source: *Author*

Also, according to Jonson-Neyman (1950), Moderation is present because Y does not equal zero for any values of X within the confidence intervals within a relevant range of X values (Johnson & Fay, 1950) In this interaction, Y = 0 does not fall within the confidence interval for all values of X less than 0. 011. This confirms the Analysis made using SPSS/AMOS statistical tools.

Control: Education's regression weight β is 0.5381, showing a significant positive relationship with FDI (p = 0.0212). Years of Investment's β is 0.4102, also significantly positive (p = 0.0266). Social Desirability's β is -0.3897, not significant (p = 0.1514). We cannot reject the null hypothesis that there is no relationship between Social Desirability and FDI inflow.

Results of Predictive Analysis - ARIMA:

ARIMA is versatile for time series forecasts. Captures autocorrelation, and time dependencies. Strengths: easy interpretation, efficiency, robustness, missing data handling. Output: expected values, confidence intervals (blue line, shaded). MAE, RMSE, PME, MAPE, and MASE assess quality. MAE averages absolute differences, and RMSE squares, and emphasizes larger errors. Lower values (e.g., MAE 2.2907, RMSE 2.74782) signal a better fit. Measures for the training set, and generalization need separate test sets. ARIMA forecast with 95% CI is shown in Figure 8 for ten years.

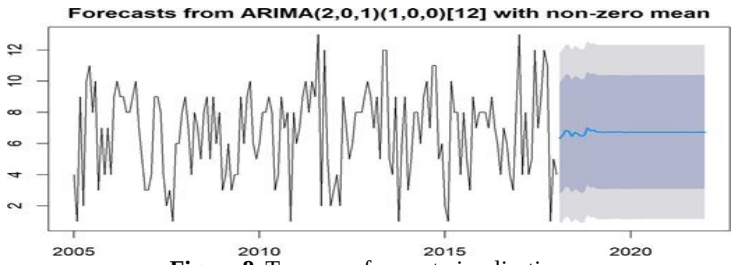


Figure 8. Ten years forecast visualization
Source: *Data Processed with R, 2023*

The Ljung test showed no autocorrelation, confirming data independence. Residuals lacked significant information or correlation, resembling white noise. The model used was ARIMA (2,0,1) (1,0,0) [12] with a non-zero mean (Ulf Andersson, 2019). Given those mentioned above and having analyzed the outcome, Figure 8 clearly shows that using the same data with a non-zero mean. ARIMA predicts that the FDI inflow will decline and remain unchanged for the next ten years. It continues in this trajectory unless the perception of both existing and potential foreign investors of the combined investment facilitation and the ease of doing business services change.

Python - *Error Analysis:* Evaluation metrics: The parameter error allows for efficient and compact analyses (Fabian, 2023) SME and RMSE were calculated. MSE is 16.5, and RMSE is 4.06, indicating forecast accuracy. Lower RMSE suggests better accuracy, but the interpretation depends on context.

Forecasting for out-of-sample data: Python forecasts for new data and assesses the model's generalization. Time series testing with rolling origin, recalibration, and multiple test periods indicates an enhancement in the analysis and better reliability and efficiency (Leonard J, 2000). Testing is set for evaluation, not selection. Code generates a 100-step forecast, plots FDI Inflow values, observed and forecasted, with confidence interval comparing forecast to observed, and gauges forecast uncertainty, as shown in Figure 9.

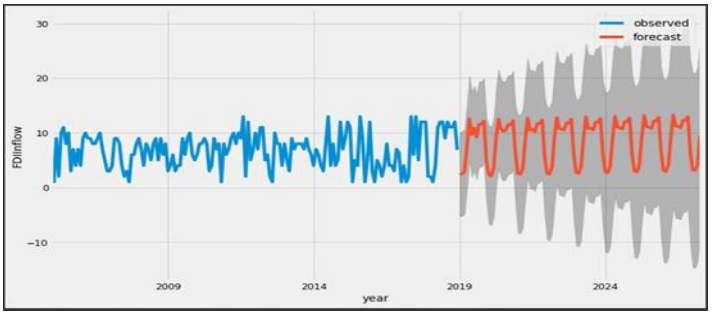


Figure 9. Observed and forecasted for ten years
Source: *Data Processed with Python, 2023*

Result and Findings Summary:

The model captures FDI Inflow seasonality, widening confidence intervals for distant forecasts. Predicted moderate-steady FDI increase over a decade with 90% C.I. Results contingent on service quality, and reforms for practicality per World Bank (Bank, 2020). Study suggests ease of doing business ratings alone may not attract investors to Nigeria or Sub-Saharan Africa. Combining them with investment facilitation helps. ARIMA and Python models differ in FDI prediction. Regional differences and sample size affect investment facilitation and ease of doing business in high EDB-rating countries.

Discussions

This empirical paper employs machine learning models to forecast potential foreign investment decisions, considering moderated effects. Deep learning predicts gradual but insignificant FDI inflow to Nigeria over 2018-2028, linked to ease of business and investment facilitation. ARIMA in R and Python predicts stability. Findings affirm that investment facilitation strengthens the Ease of Doing Business and FDI relationship; higher facilitation boosts the positive effect of Ease of Doing Business on FDI. The analysis partially supports this hypothesis, with the effect influenced by sample size. The research contributes

methodologically and regionally, offering insights for policymakers and business leaders. Our findings reinforce previous literature that suggests EODB ratings do not typically moderate the impact of certain risk factors for specific countries within the same region (Aisjah et al., 2020). Our results align with Nai-Hwa Lien and Shu-Luan Kao's (2008) research, which suggests that quality plays a more significant role in service satisfaction than other factors. Specifically, functional quality is a more substantial determinant of service satisfaction, and the relationship between quality and satisfaction depends on the level of differentiation of other alternatives (Lien & Kao, 2008).

4. Conclusion

The Nigerian and any other SSA investment facilitation agencies should change their strategies and approach to attract foreign capital, especially in greenfield and related investments. For example, FDI Intelligence (2021) indicates that for the first time, renewable energy was the biggest recipient of the FDI (Intelligence, 2022). Post-pandemic economic recovery is paramount so that international perception of those countries will shift with a series of reforms to revamp their economies (Intelligence, 2022)

Given the predicted FDI inflow decisions based on the interacted effect of ease of business with investment facilitation, we strongly suggest strengthening and integrating R&D and marketing (Abbie & John R, 1996) to reflect both micro and macro trends that would reshape the post-pandemic economic landscape.

Developing economies, including Africa, have low FDI compared to developed and transitional economies. African IPAs should improve business services by looking outside the traditional inflows of FDI to Africa (Darley, 2012). Nigeria's low ease-of-doing-business score since 2011 suggests collaboration with PEBEC and adopting successful regional IPA models for improvement. This study uses machine learning to forecast FDI, emphasizing investment facilitation and business ease, focusing on Nigeria with ARIMA and Python models. In terms of research limitations, the findings are specific to Nigeria and Sub-Saharan Africa. Caution is needed when applying them to different regions and countries. The study's limitations include reliance on survey data from specific regions, potentially limiting generalizability. Additionally, the complex modeling techniques (ARIMA, SEM) might not capture all nuances in FDI decision-making. Future research could expand geographic scope, incorporate more diverse data sources, and explore other modeling approaches to enhance understanding of FDI inflows' dynamics.

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