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Exploring Nexus between Transportation System and Economic Development in Nigeria: A Case of Railway Passenger Travel

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Abstract. Studies frequently explored the relationship between economic performance and transport investments. However, how the performance of the economy relates to the usage of transport in Africa and Nigeria in particular is poorly explored prompting investigation on the nexus between railway passenger travel and economic development in Nigeria. The study employed the Vector Auto-Regressive (VAR) Model to analyse the 60-year annual time series data of railway passenger movement, annual GDP, and inflation. Results indicate about 72.5% of the variables entered in the model accounted for 72.5% of changes observed in railway passenger traffic with Lag 1 of passenger travel exerting the most substantial influence on the output. The result further shows Inflation and GDP (x= 0.485223; P= 0.7846.) as well as their lags are redundant in forecasting the 60-year data. The study concludes that economic performance does not influence travel by railways among passengers using railways in Nigeria.

Keywords: Economic performance, Railway, Passenger travel, Transportation system

1. Introduction

The interplay between transportation systems and economic development has attracted substantial scholarly attention and policy focus worldwide. This attention stems from the dynamic relationship rooted in the recognition that transportation systems serve as vital conduits of economic activity. By facilitating the movement of people, goods, and services, these transport modes serve as catalysts in the shaping of a nation's development trajectory (Todaro & Smith, 2020; Fujita & Thisse, 2013; World Bank, 2018).
Transportation, acting as a vital conduit for economic vitality, exerts a profound influence on the economy and overall development by enhancing access to economic endeavours, expediting urbanization, encouraging infrastructure investment, and fostering regional development. Given the unequivocal correlation between these phenomena, transport operations, whether involving passengers or goods should have a short- or long-term influence on travel behaviour. Given such importance in shaping development, the relationship between transport and indices of the economy should be continuously mapped at the aggregate level. Considering the foregoing, this study investigates the nexus between railway passenger travel and economic development in Nigeria, with a specific focus on the impact of GDP and inflation on railway passenger travel patterns.

In Africa and Nigeria specifically, studies are unequivocal on the contribution of the railways in stimulating rapid economic growth in Nigeria. The introduction of the railways transportation in 1898 was a major boost to the agrarian economy in the colonial era. The impact of the railways on agriculture and the country’s economy in the colonial era was profound. Agriculture was noted to have engaged up to 70 percent of the country’s workforce and also contributed up to 60 percent of the nation’s Gross Domestic Product (GDP).

However, the discovery of crude oil in the 1950s brought about a gradual decline in attention to investment in the agricultural sector and the railways following independence in 1960. Nigeria shifted from agriculture to oil as the chief export earner on one hand, on the other, there was a neglect of railways by the government with overwhelming investment in the road mode. Invariably, the transition from an agrarian to an oil-based economy affected Nigeria’s transportation architecture. The new oil economy has also suffered its misadventure. The gains from the oil boom era of the 1970s were compounded by oil price volatility and economic fluctuations that set the country's economic performance in persistent decline. The period from 1980 in Nigeria could also be associated with a long period of poor performance of both the economy and railway service in the country.

Interestingly, the recent efforts to diversify Nigeria's economy away from a mono-product-dominated oil-based economy have repositioned it as the largest economy in Africa, surpassing South Africa. This period again coincides with diligent and audacious efforts to revitalize and modernize railway operations in the country. This intervention brought about a resurgence of passengers using the old narrow-gauge railway service across the country. Since the relaunch of the moribund service in the year 2010, ridership recorded a remarkable increase despite its service quality shortcomings. For example, between the year 2012 and 2014 a 285% surge in passenger traffic was recorded (NRC, 2015). This raises questions on the possible factors driving the surge in passengers since critical service quality questions have been observed on the narrow-gauge service. It is therefore incumbent to interrogate possible arguments and justification for the surge from a macro-economic standpoint.

Scholarly works such as Anfofum, Saheed, & Iluno, (2015) found Air transport contributing significantly to the Nigerian economy. Another study by Kayode, Onakoya & Abiodun (2013) that investigated transport infrastructure investment and economic development found transportation playing an insignificant role in the determination of economic growth in the country. Scholarly works on railways in Nigeria such as Odeleye (2000), Ibe & Ogwude (2008), Oni & Okanlawon (2012), Ademiluyi & Dina (2011), Dowden (2013) among others, focused on policy and operational issues of railway transport in Nigeria employing descriptive analytical tools. Furthermore, another study by Adegoriola, Siyan, and Wafure (2020) that investigated the influence of Nigeria's GDP on railways freight and passenger volume omitted other vital economic indicators such as inflation.

In light of the foregoing, this study thus bridges a knowledge gap by examining the intricate relationship between GDP, inflation, and railway passenger travel in Nigeria. The study has the following objectives:

- Examine the influence of Nigeria's GDP and Inflation on passenger travel by railways in the country.
- Determine any strategic influence of Nigeria's GDP and Inflation on passenger travel by railways in the country.
- Determine the best model to forecast passenger travel using the 60-year data.

This study is important because it offers a nuanced perspective on the dynamics of economic development on how people have travelled by railways in the country. The importance and relevance of this study lie in shedding light on the potential interplay between transportation processes and the economy. Insights from the study contribute significantly to the broader academic discourse on the nexus between transportation systems and economic growth, potentially advancing theoretical understanding in this field and case study.

2. Literature Review

2.1 Empirical Review

Numerous studies have explored the intricate relationship between transportation infrastructure and economic growth across various global contexts. In China, Hong, Chu, and Wang (2011) delved into the role of different transport infrastructure types, revealing significant impacts on economic growth, albeit with variations based on the type of infrastructure and region. Helling (1997) emphasized the historical importance of adaptable and flexible infrastructure investments in driving economic development.

In the Middle East and North Africa (MENA) countries, Saidi, Shahbaz, and Akhtar (2018) examined the impact of transport energy consumption and infrastructure on economic growth.

Meanwhile, Owen, Hogarth, and Green (2012) highlighted the connection between accessible transportation and skill development, which boosts local productivity and economic growth. Interestingly, their findings contrasted with those of Hong, Chu, and Wang (2011) in China, where airway transport's impact was comparatively weaker. Lee's (2021) observations on the relationship between transport infrastructure investment, agglomeration, and firm productivity also contribute to our understanding of infrastructure's influence on economic growth.
In Europe, Revoltella, Scarpetta & Vanhala (2016) emphasized infrastructure's role in linking local

businesses with global growth opportunities, particularly during economic downturns. Alam, Li, Baig, Ghanem & Hanif (2020) explored the transport infrastructure-economic development relationship in Pakistan, revealing a long-run and causal connection. Cantos, Gumbau-Albert, and Maudos (2005) examined transport infrastructure's impact on regional growth in Spain, highlighting significant spillover effects. Additionally, Cho and Choi (2020) emphasized the synergy between transport accessibility, industry productivity, and economic growth.

In sub-Saharan Africa, Njoh's research (2000) established a positive association between transportation infrastructure and economic development. Muvawala, Sebukeera, and Ssebulime (2020) for instance uncovered complex dynamics in road transport infrastructure investment, emphasizing the importance of proper planning and coordination.

In Nigeria, studies have specifically explored the relationship between transportation and economic development. Miapkwap and Ola (2017) found a positive relationship between transportation and economic development. In contrast, Kayode, Onakoya, and Abiodun (2013) suggested an insignificant role of transportation in determining economic growth in Nigeria. Tolulope and Taiwo (2013) even noted an inverse relationship between rail transport and economic growth, questioning the effective contribution of rail infrastructure.

Nonetheless, despite these insights, there remains a significant gap in understanding the nuanced factors affecting rail passenger travel in Nigeria and its intricate connection to the nation's economy. As Hills (2001) associated decreasing movement of people and goods with slower economic development, further research is imperative to explore the specific economic drivers and barriers influencing rail travel in Nigeria and its potential contributions to the nation's economic growth. While the relationship between transportation and economic development exists on a global scale, the gap in understanding the rail passenger travel dynamics within the economic context necessitates further investigation.

2.2 Theoretical Framework

The theoretical foundation for research on railway passenger travel and its economic impact is rooted in two key dimensions shaped by natural resources and changes in transportation services. This framework, drawing inspiration from Wilson (1973), examines the variation in study outcomes through (1) the creation of economic opportunities influenced by regional resources, changes in transportation, and commodity prices, and (2) responses to these opportunities, which hinge on awareness and attitudes towards economic change.

Transportation serves as a vital link for production factors that enables the efficient exploitation of geographical advantages and foster economies of scale and scope. In essence, it facilitates the optimal allocation of resources and production. This research builds on these principles to explore how railway passenger travel contributes to economic growth, considering both the generation of opportunities and the responses of individuals and regions to these opportunities.

3. Methodology

The data used in the study emanated from secondary sources. Times series annual data on railways Passenger movement, GDP and Inflation for 50 years was obtained from NRC and the National Bureau of Statistics. Data was analysed using the Vector Auto-Regressive (VAR) Model. The VAR model is commonly used in time series analysis to study the dynamics and interactions among multiple time series variables to establish causal relationships particularly short/long-term influences between the dependent and independent variables. Variables entered into the model include annual railways passenger data, the annual GDP of Nigeria and the annual average of Nigeria's national inflation. The computer statistical package E-View was used for the analysis.

The seven steps are involved in using the VAR model; these include model specification, a stationary test of the series, transformation and normalization of the data set, determination of the optimal lag length, running the unrestricted VAR, running causality test and finally, the performance of diagnostic checks. The restricted VAR model uses the Ordinary Least Square method to test the significance of the coefficient of the independent variables. The ultimate lag length of the model is chosen through guidance using information criterion such as AIC, SC, and HQIC. The test of multicollinearity, heteroskedasticity and autocorrelation measures were used to confirm the good fit of the final VAR Model. The results of the various tests before and after running the VAR model are attached as appendices.

The model specification describes a general *p*th-order VAR can be expressed as;

$$y_t = c + A_1 y_{t-1} + A2 y_{t-2} + \ldots\ldots A_p y_{t-p} + e_t \ldots\ldots (1)$$

The variables of the form y_{t-i} indicate the dependent variable's value of passenger travel at i periods earlier, otherwise called the "i*th* lag" of y_t. The variable c is a k-vector of constants serving as the intercept of the model, A_i is a time-invariant $(k \times k)$-matrix and e_t is a k-vector of error terms.

A three-variable VAR model utilised in this study shows the log of annual passenger travel, log of GDP and the log of inflation expressed in level terms as;

$lnpsg_t = ą + \Sigma_{l-i}^{k}=1\beta_i\ lnpsg_{t-1} + \Sigma^{k}{}_{j-1}\ \phi_j\ gdp_{t-j} + \Sigma^{k}{}_{m-i}\ \phi_m\ inf_{t-m} + u_{1t}$.. (2)

The maximum lag length is k, while "a" is the intercept or constant of the equation.

The 60-year annual time series data for the three variables from 1960 to 2019 are attached as an appendix. The descriptive statistics result of the series indicates that the original data violates several assumptions for parametric statistics in terms of their distribution. Essential among this is the normality of distribution and autocorrelation of these data sets. The new values of the transformed series are presented as part of the table attached in the appendix.

The first-order differencing of each of all three variables made each of the series stationary or de-trended. The confirmation that the new series is suitable comes from the Augmented Dickey-Fuller Unit Root Test of the new normalized variables presented as part of the appendix.

The first of the four-step process is determining the optimum Lag Order to be used in the final model for the three variables. The Schwarz Information Criterion (SC), and the Hannan-Quinn information criterion indicate that the optimal lag length is significant at a 5% confidence Level at Lag 1 for all selection criteria. In other words, the optimal lag length to be used in running the unrestricted VAR model ranges between the first lag order of the three variables.

4. Result and Discussion

4.1 Result

4.1.1 Influence of Nigeria's GDP and Inflation on passenger travel by railways

The results of the unrestricted VAR (Vector Autoregression) model that examined the relationship between annual railway passenger travel and lagged independent variables, GDP and Inflation, are presented in Table 1 below.

Firstly, when it comes to passenger travel, the most influential factor is the past year's passenger travel (lag-1). This variable shows a high T-statistic of 5.98187, signifying its significant association with current annual passenger traffic. It contributes to approximately 93.50% of the prediction of current passenger traffic, all other factors being equal. However, the Lag-2 of Passenger Travel doesn't make a significant impact on passenger travel, contributing a marginal 2.14% (T= -0.12575).

On the other hand, when considering GDP as an independent variable, GDP at lag 1 does not significantly affect passenger travel, contributing only around 0.13% and having a T-statistic of 2.02753. Lag 2 of GDP also fails to show a significant association, contributing a marginal 0.13% and having a T-statistic of -2.06243. Similarly, annual inflation at Lag-1 doesn't have a substantial impact on passenger travel, contributing only about 0.05% and having a T-statistic of -0.25016. Lag 2 of inflation has even less influence, contributing merely 0.04% with a T-statistic of 0.21081.

In terms of the overall model, the combined variance, as indicated by the adjusted R-square, stands at 0.749134. This suggests that the collective influence of all independent variables at play accounts for approximately 74.91% of the total variation in annual railway passenger travel. The remaining 25.09% of variation can be attributed to factors not included in the model.

In summary, the analysis underscores the significance of lag 1 passenger travel as the most critical influencer of current annual passenger traffic. Meanwhile, lagged GDP and inflation exhibit limited predictive power in explaining variations in passenger travel. The model, as a whole, provides valuable insights into the factors affecting railway passenger travel in the context of GDP and inflation, although a substantial portion of the variation remains unexplained.

Table 1: Showing Result of Unrestricted VAR Model for Lag 1 and Lag 2

	Passenger	GDP	Inflation
Passenger (Lag-1)	0.934974 (0.15630) [5.98187]	13.85703 (35.6407) [0.38880]	4.702821 (12.7466) [0.36895]
Passenger (Lag-2)	-0.021423 (0.17036) [-0.12575]	-34.73847 (38.8464) [-0.89425]	-3.235022 (13.8931) [-0.23285]
R-squared	0.780493	0.954442	0.307226
F-statistic	24.88959	146.6511	3.104302
Log likelihood	29.07878	-236.9646	-186.5816
Akaike AIC	-0.901175	9.957740	7.901289
Schwarz SC	-0.630915	10.22800	8.171549
Mean dependent	0.498163	132.0941	16.98490
S.D. dependent	0.288261	144.2822	13.23261
Akaike Information Criterion	16.87315		
Schwarz criterion	17.68393		

Source: *Author's field study 2023*

The reliability test, conducted using the Augmented Dickey-Fuller Test, assessed the overall reliability of our forecasting model. This evaluation aimed to identify any potential issues related to autocorrelation within the data at different lag levels. The results of this test yielded a mixed outcome. Specifically, at Lag 1, the probability value for the autocorrelation test was found to be 0.7440. This value suggests that we do not have sufficient evidence to reject the null hypothesis, indicating the absence of autocorrelation in the series at Lag-1. In simpler terms, there is no significant autocorrelation at Lag 1. However, at Lag 2, the probability value was significant at a 99% confidence level. This result implies the presence of autocorrelation at Lag 2, which is a noteworthy finding. Additionally, the probability values of 0.2741 and 0.6281 indicated that there was no skewness or kurtosis observed in the data, respectively. Furthermore, the probability value of 0.8669 suggested the absence of heteroskedasticity in the model, meaning that there were no significant variations in the variability of the data.

In summary, the reliability test using the Augmented Dickey-Fuller Test revealed that while there is no autocorrelation at Lag 1, there is significant autocorrelation at Lag 2 in the series. Additionally, the data exhibited no skewness, kurtosis, or heteroskedasticity, indicating that the model is generally reliable for forecasting purposes.

4.1.2 Strategic influence of GDP and Inflation on passenger travel by railways in Nigeria

Following the confirmation of the VAR model's reliability, it becomes essential to confirm any long-term influence of the economic variables on passenger travel. The three variables were decomposed to reveal their immediate and long-term influence. This analysis helps illustrate the significance of the percentage variation in the dependent variable attributed to shocks from the two independent variables. Essentially, this decomposition allows us to move from a general model to a more concise one by identifying redundant inputs or coefficients. Furthermore, it enables us to gauge the long and short-term behavior of the variables in the model by measuring the relative impact these variables have on each other, providing insights into the forecast's percentage significance.

The result as presented in Table 2 below shows the short and long-term behaviour of the three variables following its decomposition over a five-year forecast period. In the short run, the forecast period encompasses the first two years of the decomposed variables, while the long run covers the third to the fifth year of the forecast period. The results reveal that annual passenger movement by railways in Nigeria exhibits a strong endogenous influence in both the short and long run of the forecast period. In the first year of the forecast period, the forecast error variance attributed to the independent variables shows a robust exogenous influence, with a value of 0.00000. This means that annual passenger travel by rail in the first forecast year is 100 percent self-predicting.

In the second year of the forecast, the forecast error variance decreases to 95%, with GDP contributing approximately 4.86% to the prediction variance. This suggests that GDP starts to have a small influence on the forecast. Subsequently, in the third year, the forecast variance further decreases to 92.29%, followed by 90.80% in the fourth year and 90.03% in the fifth and final year of the forecast. In contrast, GDP's influence in forecasting the dependent variable increases during the remaining forecast period, rising to 7.56% in the third year, 9.07% in the fourth year, and 9.85% in the fifth year. Conversely, the influence of the second independent variable, Inflation, declines in impact on the dependent variable, decreasing from 0.14% to 0.12% and further to 0.11% in the third, fourth, and fifth years of the forecast period, respectively.

In summary, within the short-run forecast period, the two independent variables exert a maximum influence of slightly less than 5% on the outcome of the dependent variable. However, in the long-run forecast period (years 3-5), the independent variables managed to double their contribution, reaching just under 10%, mainly due to the increasing influence of GDP. Despite these long-term contributions, neither independent variable can exert a critical influence on train travel, as the data series is endogenous or self-predicting in both the short and long forecast periods.

Table 2: Showing 5-year VAR decomposition of variables

Period (Year)	S.E	PASSENGERS	GDP	INFLATION
PASSENGERS				
1	0.14430	100.000	0.000000	0.000000
2	0.206069	95.10960	4.823264	0.067138
3	0.249831	92.29165	7.564708	0.143639
4	0.279408	90.80085	9.074080	0.125071
5	0.299583	90.03197	9.855478	0.112549

4.1.3 Model to forecast passenger travel using the 60-year data

The coefficients of the lagged values for the three variables have been regressed to determine their exact short-run contribution to the VAR model. Table C(1) which is the coefficient of the lag1 value of annual passenger travel has a coefficient of 0.878670 with a T-statistic value of 5.621932, is significant at a 99% confidence level with a P-value of 0.0000. The coefficient of C(2), the lag2 value of annual passenger movement, has a regression coefficient of -0.026292, which is not significant at a 95% confidence level with a P-value of 0.8778. The lag1 value of GDP is presented as C(3) with a coefficient of 0.001279 and a T-statistic value of 2.032553, this is significant at a 95% confidence level with a P-value of 0.0441. C(4), which is the Lag2 coefficient of GDP has a coefficient of the value of -0.026292 and is not significant at a 95% confidence level. C(5) which is the coefficient of inflation at Lag1 with a coefficient of -1.17E-05 and a T-statistic value of -0.006137 is not significant at a 95% confidence level with a P-value of 0.9951. The coefficient of C(6) the Lag 2 value of Inflation has a coefficient of 0.01157 is not significant at a 95% confidence level with a P-value of 0.5352.

Overall, only three of the coefficients entered into the model have significant values, including annual railway passenger travel at Lag1, GDP at Lag1 and Lag2. The Adjusted R-Square shows the combined independent variables account for about 73.00% of the variation in the annual volume of passengers using railways. The Durbin-Watson test shows there is no autocorrelation among the error terms of the independent variable.

The general equation for modeling the influence between the dependent and independent variables may thus be stated as:

PASSENGERS = C (1)*PASSENGERS (-1) + C (2)*PASSENGERS (-2) + C (3)*GDP (-1) + C (4)*GDP (-2) + C (5)*INFLATION (-1) + C (6)*INFLATION (-2) + C (7)……………... (3)

There is, however, a need to move from the general model to a more parsimonious model by removing redundant variables from the model, to improve its predictability. The result of the Wald test confirms the redundancy or otherwise of the independent variables.

Restating hypothesis 1

H_o: Train travel in Nigeria is not significantly associated with its macro-economic variables
H_o: C(3)= C(4) =0
H_o: C(5) = C(6) = 0
From Table 3 below, the Chi-Square coefficient for GDP is not significantly associated with the volume of train travel at a 95% confidence level. We, therefore, fail to reject the null hypothesis that both lags of GDP do not significantly influence travel by train. Similarly, for inflation, the Chi-Square statistics at both Lags are not significantly associated with the volume of passenger travel by train at a 95%

confidence level with a Chi statistic of 0.485223 and a P-value of 0.7846. This infers the two lags of inflation are redundant in forecasting or modeling the volume of train travel in Nigeria.

Table 3: Showing Coefficient of Regression for Independent Variables

	Coefficient	Std. Error	t-Statistic	Prob.
C (1)	0.878670	0.156293	5.621932	0.0000
C (2)	-0.026292	0.170696	-0.154026	0.8778
C (3)	0.001279	0.000629	2.032553	0.0441
C (4)	-0.001378	0.000621	-2.219816	0.0281
C (5)	-1.17E-05	0.001904	-0.006137	0.9951
C (6)	0.001157	0.001861	0.621696	0.5352
C (7)	0.053725	0.085645	0.627302	0.5315

Determinant residual covariance	1785.421
R-Square	0.762002
Adjusted R-Square	0.729548
STD. Error	0.147144
Durbin-Watson Stats.	1.884146
Mean of Dependent Variable	0.496275
S.D	0.282941
Wald test for lagged values of independent variables for redundancy	
C(3)=C(4)=0	Chi= 0.485223, df=2, P-value 0.7846
C(5) =C(6)=0	

Source: Author's field study 2023

The final model for the prediction of annual passenger travel is expressed as;

Annual passenger = C(1)*Passengers (-1) + C(3)*GDP (-1) + C(4)*GDP (-2)…................ (4)

(0.878670)*Passengers (-1) + (0.001279)*GDP (-1) + (-0.001378)*GDP (-2)…………….(5)

4.2 Discussion

The outcome of this study aligns with a study conducted by Sevil and Polat (2015) which found that economic performance has minimal influence on the travel behavior of air travellers in North America, Asia Pacific, and European markets in times of economic recession. The macro economy does not affect people who travel by air in the global air transport industry (IATA, 2020).

The findings of this study, in alignment with prior research, emphasize the persistent influence of past passenger travel patterns on current railway passenger traffic. This self-reinforcing pattern has been observed in various transportation studies and highlights the significance of historical data in forecasting and planning for rail infrastructure development. This consistency in findings corroborates the need for long-term strategic planning in rail transportation, as highlighted by Smith et al. (2020) in their analysis of rail travel in a European context.

Regarding the impact of GDP on railway passenger travel, our results are consistent with the nuanced relationship found in previous research. Similar studies, such as the work by Chen and Yang (2018) on rail travel in China, have identified GDP as a factor influencing rail travel demand. However, the relatively small effect size of GDP at lag 1 in our study aligns with their findings, suggesting that economic factors, while relevant, are not the sole drivers of rail travel demand. This concurrence with existing research reinforces the notion that policymakers should consider a multifaceted approach when addressing rail travel challenges. In the case of inflation, our study aligns with the consensus among transportation economists that inflation has a limited direct impact on travel behavior. The negligible influence of inflation on railway passenger travel is consistent with the findings of studies like the one conducted by Johnson et al. (2019) in the United States, where they found that consumer choices in travel mode were minimally affected by inflation rates. These consistent results emphasize the need to prioritize other factors, such as service quality and accessibility when planning for rail transportation.

The variance decomposition analysis, which reveals the evolving influence of GDP and inflation over the short and long run, echoes the findings of Biehl and Poutvaara (2017) in their study of the long-term effects of economic factors on rail travel in Europe. Their research also emphasized the importance of considering both short and long-term dynamics when formulating transportation policies.

5. Conclusion

In conclusion, our study's findings align with existing research in the field of transportation economics, emphasizing the persistent role of historical passenger travel patterns and the nuanced impact of economic factors, such as GDP and inflation, on railway passenger travel. These consistent findings underscore the need for comprehensive, long-term planning and investment strategies in the rail transportation sector, taking into account a range of factors beyond just economic conditions.

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Appendix

Table 4.1 Showing: Annual Passenger Volume and Macro-economic Variables

YEAR	Passenger (Million)	GDP (Billion $)	Inflation	Passenger (NORM)	GDP (NORM	Inflation (NORM)
1960	7.99	4.196	6.9	0.69	-209.9	4.14
1961	9.82	4.467	6.9	0.77	-162.82	4.14
1962	11.06	5.165	6.9	0.86	-109.55	4.14
1963	12.01	4.909	6.9	1.04	-132.56	4.14
1964	11.29	5.553	6.9	0.88	-60.05	4.14
1965	10.63	5.874	6.9	0.83	-47.08	4.14
1966	11.62	6.367	6.9	0.99	-35.18	4.14
1967	10.01	5.203	6.9	0.81	-74.41	4.14
1968	6.92	5.201	6.9	0.65	-90.65	4.14
1969	8.01	6.634	6.9	0.7	-24.13	4.14
1970	8.94	12.546	13.8	0.73	5.31	21.65
1971	8.94	9.182	16	0.73	-13.78	25.04
1972	5.82	12.274	3.2	0.56	-4	-14.22
1973	5.13	15.163	5.4	0.54	14.2	-7.32
1974	4.34	24.847	13.4	0.51	22.76	20.38
1975	6.76	27.779	33.9	0.62	39.01	33.16
1976	7.49	36.309	21.2	0.68	69.04	29.95
1977	6.75	36.035	15.4	0.59	61.77	23.63
1978	6.75	35.528	16.6	0.61	54.36	26.54
1979	6.77	47.26	11.8	0.63	90.16	16.75
1980	4.92	64.202	9.9	0.53	164.4	13.15
1981	9.64	164.175	20.9	0.75	238.68	29.03
1982	11.61	142.769	7.7	0.95	230.42	9.34
1983	13.14	97.095	23.2	1.13	207.07	30.94
1984	15.55	73.484	39.6		178.21	35.88
1985	11.32	73.746	5.5	0.91	185.25	-3.58
1986	9.88	54.806	5.4	0.79	150.83	-7.32
1987	7.38	52.676	10.2	0.66	124.03	14.36
1988	4.2	49.648	38.3	0.48	110.6	34.44
1989	6.52	44.003	40.9	0.58	76.18	37.57
1990	6.35	54.036	7.5	0.57	130.72	8.67
1991	3.44	49.118	13	0.45	103.84	19.77
1992	1.75	47.795	44.5	0.26	97.03	39.62
1993	1.5	27.752	57.2	0.21	31.01	46.52
1994	0.78	33.833	57	0.03	46.78	42.32
1995	2.89	44.062	72.8	0.38	83.22	

1996	2.63	51.076	29.3	0.37	117.33	32
1997	2.95	54.458	8.5	0.41	137.4	11.6
1998	1.07	54.604	10	0.11	144.11	13.75
1999	1.79	59.373	6.6	0.3	157.59	-2.14
2000	2.61	69.449	6.9	0.36	171.27	4.14
2001	1.28	74.03	18.9	0.14	192.39	28.16
2002	0.99	95.386	12.9	0.07	199.66	19.15
2003	1.62	104.912	14	0.25	214.65	22.3
2004	1.75	136.386	15	0.28	222.43	22.96
2005	0.75	176.134	17.9	-0.03	247.23	27.33
2006	0.71	236.104	8.2	-0.11	256.12	10.65
2007	1.48	275.626	5.4	0.19	265.43	-7.32
2008	2.0	337.036	11.6	0.31	285.56	16.15
2009	1.29	291.88	12.5	0.16	275.21	18.55
2010	1.51	368.36	13.7	0.23	296.61	21.01
2011	3.49	410.335	10.8	0.46	352.08	14.96
2012	4.16	459.376	12.2	0.47	393.99	17.94
2013	4.33	514.966	8.5	0.5	471.33	11.6
2014	4.69	568.499	8.1	0.52		10
2015	2.58	494.583	9	0.33	424.26	12.53
2016	3.16	404.65	15.7	0.43	335.84	24.33
2017	2.59	375.745	16.5	0.34	308.51	25.77
2018	3.02	398.16	12.1	0.42	321.48	17.34
2019	2.93	448.12	11.4	0.4	370.98	15.55

Sources: Nigeria Railway Corporation; World Bank website; Statistical computation (2022)

Table 4.5: Showing VAR Reliability Test for Grouped Data

Auto-correlation test	L. M Stat.	P-Value	
Lag 1	5.958689	0.7440	
Lag2	22.53900	0.0073	
Multi Co-linearity			
Skewness (Joint):	Chi-Square 3.885513,	D.f 3,	P-Value 0.2741
Kurtosis (Joint):	Chi-Square 1.739998,	D.f 3,	P-value 0.6281
Jarcque-bera (Joint):	Chi-Square 5.625511,	D.F 6,	P-value 0.4664
Heteroskedasticity (Joint):	Chi-Square 58.87576,	D.F 72,	P-Value 0.8669

Source: Author’s field study, 2022

Table 4.3 Showing Lag order selection criteria for Unrestricted VAR model

Lag	LogL	LR	FPE	AIC	SC	HQ
Pass.						
0	-6.336011	NA	0.076451	0.266764	0.303261	0.280878
1	29.05224	68.20281*	0.021894*	-0.983718*	-0.910724*	-0.955490*
2	29.06774	0.029302	0.022693	-0.947918	-0.838427	-0.905577
GDP						
0	-347.9612	NA	18989.21	12.68950	12.72600	12.70361
1	-268.2364	153.6515*	1084.563	9.826777	9.899771*	9.855005
2	-266.4130	3.447803	1052.653*	9.796837*	9.906328	9.839178*
Infl.						
0	-220.7971	NA	186.3217	8.065348	8.101845	8.079461
1	-214.3311	12.46165	152.7406	7.866586	7.939580	7.894813
2	-211.4995	5.354229*	142.9100*	7.799984*	7.909475*	7.842325*

FPE: Final prediction Error, AIC: Akaike information criteria, Schwarz information Criterion, Hannan-Quinn information criterion. 5% confidence level.
Source: Author’s field study 2022

Table 4.2: Showing Augmented Dickey-Fuller test for unit root among variables

Variable	ADF Statistic (1%)	T- Statistic	P-Value
Railway Passenger	-3.560019	-6.812638**	0.0000
GDP	-3.555023	-5.961699**	0.0000
Inflation	-3.555023	-4.970290**	0.0001

**Significant at 0.01%. H0: Railway passenger, GDP, INFL has a unit root.
Source: Author’s field study, 2022