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Productivity income nexus in Nigeria: Empirical lessons from COVID-19 lockdown

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Abstract In an attempt to control the coronavirus, governments worldwide imposed lockdown measures, yet the consequences on productivity income for microeconomic policy were not clearly known, especially in developing countries. This study examined the effect of the COVID-19 pandemic on the productivity and income of Nigerian households under strict lockdown during 2020 using a cross-section based online survey. Participants were sampled from Nigeria's geopolitical zones via a snowball sampling method. A total of 467 household data were utilized for the analysis. Descriptive statistics, hierarchical and stepwise regression models were applied to the data. Results show that the COVID-19 lockdown negatively affected productivity by 71.3% and income by 58.2%. Younger populations were more affected (β = -0.159, $p<0.05$) as well as people with marital responsibilities ($\beta = 0.617$, $p<0.05$). The global pandemic had negative consequences on the productivity of young populations. The reducing effect of the pandemic on income had the potential to add a greater burden to the household welfare of family people. This study provides an empirical insight into the microeconomic effect of a pandemic on households in developing nations.

Keywords: Cross-sectional study, global pandemic, household income.

1 Introduction

The Corona virus disease 2019 (COVID-19) is a contagious respiratory disease caused by the new strain of coronavirus that results in illness in humans. COVID-19 was first detected in the city of Wuhan, China, and it started with a reported cluster of 27 pneumonia cases and later detected in 188 countries. The COVID-19 pandemic has

redefined all spheres of life given its ubiquitous effect on the socio-economic, political, and health structures worldwide, including Sub-Saharan Africa. The number of infected people and fatalities simultaneously increased and surpassed global projections. According to WHO (2024), there were over 776 million confirmed cases and over 7 million deaths. This has necessitated global action to curtail the pandemic.

Out of serious concern for public health and as part of the government efforts to stem the spread of COVID-19 pandemic, several emergency orders were given to the general public. These included lockdown, social distancing and compulsory use of nose/face masks. Despite the huge attention on public health, the economic impact of the COVID-19 pandemic had not gone unnoticed. Flights were cancelled, supply chains disrupted, and businesses were closed either through government bans or business decisions. All of these resulted in substantial loss of wages for workers and earnings for business owners in Nigeria, especially in the informal sector of the economy. These effects were more apparent and pronounced during the lockdown imposed by the federal government.

Apart from this direct impact on the economy as a whole, the case of labour market was a bit complex. In the market, many millions of workers across a large number of countries were directly impacted by lockdowns. Some were able to continue their work through teleworking or remote working arrangements. Many others had seen a reduction or complete loss of sources of their livelihood. Others, for example, workers in health or public security had experienced a huge increase in their work burden in the face of the crisis. A total of 81% of the global workforce of 3.3 billion people have had their workplace fully or partly closed (ILO 2020). This was bound to exacerbate unemployment in many countries as nearly 200 million people were reportedly expected to lose their jobs globally as a result of the COVID-19 pandemic. The COVID-19 outbreak was also expected to wipe out 6.7% of working hours across the world during the second quarter of 2020 with Arab states facing a highest decline of 8.8% (ILO 2020). Without mincing words, the loss of jobs and working hours have had negative consequences for productivity and household income. Based on a survey by the Organisation for Economic Co-operation and Development (OECD) towards the end of March 2020, 31% percent of respondents residing in G7 countries had already had their household income impacted by the pandemic and 39% expected their income to be adversely affected (Dyvik 2024).

African countries, including Nigeria were also affected economically by the COVID-19 outbreak. There were 494,459 confirmed cases in Africa with 11,674 deaths as of July 7, 2020 (Africa CDC, 2020). Africa's first COVID-19 case was recorded in Egypt on 14 February 2020. Since then, a total of 54 African countries had reported cases. Initially, mainly confined to capital cities, a significant number of countries in Africa reported cases in multiple provinces. Like many other African countries, Nigeria had 8068 total number of COVID-19 cases and 233 deaths as of May 27, 2020, and increased astronomically to 29,286 confirmed cases and 654 fatalities by July 7, 2020 (NCDC 2020). In line with the global trend in combating the pandemic, both the state and federal government had initiated measures to mitigate the spread, especially in the major cities. These included the total lockdown of Lagos, the

commercial capital of the country, Ogun State (neighbouring state to Lagos), and Abuja the administrative capital for 28 days. General commercial and business activities in these cities and some other major cities were either closed or partially opened with serious consequences for household productivity and income. Afterwards, a series of strategies for easing the lockdown were introduced in these most affected areas while other states also introduced similar measures to the community spread of the deadly virus, taking a toll on productivity in the economy. Undoubtedly, the decline in household productivity and income constituted a major problem for the Nigerian economy given the high incidence of poverty in the country. According to the World Data Lab through the World Poverty Clock report 2019, over 94 million Nigerians are estimated to be living in extreme poverty, with extreme poverty in the country increasing by nearly six Nigerians every minute. This places a huge burden on the government in terms of resources required to lift this population from extreme poverty. Thus, further lockdown of commercial and business activities in cities (especially Lagos, which is the commercial nerve centre of Nigeria and also the epicenter of the pandemic) had unimaginable impacts on household productivity and income.

Analysis of the economic impact of a pandemic is usually not easy due to the rarity of economic data (Garrett 2007). Capturing the economic impacts of epidemics and pandemics is also cumbersome for individuals, households, firms, and government given the constant occurrence of adaptations at all these levels (Lewis 2001). The effect of the pandemic on worker productivity varies across different continents and also largely depends on the level of compliance with the lockdown. Ohrnberger *et al.* (2021) recorded a variation in productivity based on good or poor compliance at 75% and 25%, respectively. Also, Gupta *et al.* (2021) in India found evidence for a reduction in income as high as 75% among daily workers. The consequence on consumption was even found to be higher. Kwon *et al.* (2024) similarly reported productivity losses due to the pandemic. An estimated reduction in paid work hours by approximately 52% was reported and a further decline in income by approximately 25%. These show clear evidence of the negative impact of the pandemic in the developed nations.

Previous studies have investigated the effect of epidemics on household productivity and income. Fan *et al.* (2018) investigated annual loss due to the global influenza pandemic and reported that about 500 billion United States dollars or 0.6% of global household income per year was lost because of the pandemic. Similar studies (e.g. Szucs 1999, Gasparini *et al.* 2012) revealed serious consequences of the influenza pandemic on household productivity and income. Drawing an inference from few economic surveys on 1918 US influenza pandemic, Garrett (2007) reported that the pandemic related mortalities reduced the supply of labour to the manufacturing companies. The aftermath of the pandemic caused an increase in real wages due to a shortage of labour. Likewise, a statistically significant positive relationship was found between the pandemic mortality rates and the subsequent growth in state per capita income. Ebola had adverse effects on household incomes in the West Africa sub-region due to a decline in productivity (Smith *et al.* 2019).

Individuals in the age bracket of 15-44 years, constituting a considerable proportion of the labour force accounted for 57% of Ebola cases while about 60-70% of households suffered a decline in income earnings as a result of the outbreak. This exacerbated poverty and food insecurity (due to the prevalence of undernourishment). Smith *et al.* (2019) also reported that around 36,000 people lost their jobs due to the 1998 Nipah Outbreak in Malaysia. This significantly affected productivity in the utility and the real estate industry, pork industry, and a host of business activities. The impact of AIDS epidemic manifests more at the household level with loss of income through lower productivity, due to incurred costs of treatment and diversion of productive time (by members of household) to the care of the sick and mourning of the lost ones (Lewis 2001).

Odusanya *et al.* (2007) examined the socio-economic effects of HIV/AIDS epidemic on people living with HIV/AIDS (PLWHA) in Oyo State, Nigeria. 50% of the respondents claimed that their health status adversely affected the level of their productivity. The paired samples t-test indicated a significant difference ($p<0.05$) between the average monthly income of respondents before and after ailment. The mean income before the ailment is substantially greater than the mean income after the ailment. Thus, the epidemic has a significant impact on productivity and eventually on the household income of the affected individuals. Walsh (2019) assessed the impacts of dengue epidemics on household labour market outcomes in Peru. Findings from the study revealed that women reduced work hours than men during the 2005-2010 intermittent dengue epidemics in the affected households. The work hours of the females declined substantially relative to males, both in terms of percentage terms relative to mean hours and the point estimate.

In light of the foregoing, it is expedient to investigate the effect of productivity and associated socio-economic variables on income during COVID-19, retrospectively. There were limited studies on the consequences of the COVID-19 pandemic on productivity and income of workers. Hence, this study adds to the body of literature on COVID-19 by focusing on productivity-income nexus due to the pandemic. The study provides useful empirical information on the effect of the pandemic on productivity and income thereby setting a pace for future planning. Consequently, we seek to ascertain the magnitude of the effect of the pandemic on productivity and income in Nigeria. Examining the economic impact of the pandemic on Nigeria is crucial and apposite as the country is among the five worst hits in Africa and also ranks as the largest economy in the region.

2 Material and Methods

This study covers the period of COVID-19 pandemic (from 30th March, 2020 to November, 2020) including the 'stay at home' order legislated by the Nigerian government to manage the COVID-19 pandemic. Data for the study were sourced through digital means. An online survey was conducted via online Google Form. Distribution of the structured questionnaire containing relevant information on the

COVID-19 pandemic, income earnings, job status and level of productivity was carried out through a widely accepted social media tool in Nigeria-WhatsApp. As the epicenter of the COVID-19 pandemic in the country was located in Southwest Nigeria at the time of the study, data from the six states that constitute the Southwestern Nigeria were processed. A total of 565 responses were obtained out of which a total of 467 (82.67%) responses were found relevant to the study. The responses were obtained several weeks after lockdown by the National and the State governments. The selected study area was confirmed to be the epicenter of the coronavirus pandemic in Nigeria. Hence, the survey focused on the residents of these states with the ability to use online surveys. We used snowball sampling techniques where the participants who received the online survey were encouraged to send it to other social media groups. This enables sharing of the questionnaire with others who share similar characteristics. Hierarchical regression and stepwise regression models were used to evaluate the role of productivity in the relationship between COVID-19 and income.

The variable *IncCovid-19* was used to represent the income level of individuals during the COVID-19 pandemic. Age was included in capturing the capacity to earn income during health crisis. Only individuals in the active age bracket were expected to have the energy to earn income during the pandemic. Gender variable was included to determine the prevalence of the subject matter among male and female individuals in the population. The education variable (*edu*) is included to measure the intellectual capacity of people to earn a living during the pandemic. The variable '*emp*' represents the employment status of individuals since only those with jobs could be linked to productivity and income earnings. Variable '*prod*' is a measure of productivity during the COVID-19 pandemic. Interaction variables are included to determine the combined effect of those variables on household income during the COVID-19 pandemic.

3 Results and Discussion

The demographic statistics of the sample show varying characteristics of the respondents (Table 1). A very low percentage (6.4%) of the sample is less than 30 years of age. Respondents in the age 31-40 age bracket were 25.7% of the sample; higher percentage (42.8%) of the respondents was in the 41-50 age range while those in the 51-60 age bracket represented 18.4%. The percentage of respondents above 60 years was relatively low (6.8%). The data showed that the respondents were adults of productive age. There were more male (72.6%) respondents than female (27.4%). The gender difference showed there were more male headed than female headed households in the study area. The majority (75.4%) of the samples were married. Less than 30 percent (23.1%) were single while less than 2% were separated or divorced. The level of education was high as most of the respondents (58.7%) were postgraduate certificate holders. Bachelor's degree holders represented 31.7% of the sample. The descriptive statistics also show that the mean age of respondents was 42.16 ± 9.57 years suggesting that they were in the active age bracket.

Table 1: Demographic characteristics of respondents.

Variable	Description	Frequency	Percentage
Age (Years)	<=30	30	6.4
	31-40	120	25.7
	41-50	200	42.8
	51-60	86	18.4
	61-70	30	6.4
	>=71	1	0.2
Gender	Male	339	72.6
	Female	128	27.4
Married/Civil status	Single	108	23.1
	Married	352	75.4
	Separated	4	0.9
	Divorced	3	0.6
Educational qualification*	SSCE	24	5.1
	ND/NCE	13	2.8
	HND/Bachelor's Degree	148	31.7
	Technical	8	1.7
	Postgraduate	274	58.7

*ND = National Diploma; NCE = National Certificate of Education; HND = Higher National Diploma

3.1 Work status of respondents before and during Covid-19 crisis

The work status of the respondents and types of occupations they engaged in are presented in Table 2. Prior to the pandemic, 84.8% of respondents were actively employed, 14.6% were able to work but unable to find a job while less than 1% (0.6%) of the sample were not qualified due to retirement. Following the spread of COVID-19, the percentage of people who were actively employed reduced to 77.1%, indicating a reduction of 7.7% in the working population or job loss of 7.7%. The percentage of those who were unable to find jobs increased from 14.6% to 27.2%, suggesting 12.6% increase in the number of those looking for job.

Table 2: Work status of respondents before and during Covid-19 pandemic.

Status	Before Covid-19 n (%)	During Covid-19 n (%)	Difference n (%)
Working	396 (84.8)	332 (77.1)	- 64 (7.7)
Unemployed	68 (14.6)	127 (27.2)	59 (12.6)
Retired	3 (0.6)	8 (1.7)	5 (1.1)
Types of Occupation	Frequency	Percentage	
Self employed	169	33.2	
Civil/Public servant	165	32.4	
Private sector employee	133	26.1	

Source: Data Analysis, 2020

Available jobs in the country vary from small business enterprises mainly for those who are self-employed, to civil/public service jobs and private sector employment.

Statistics show that 33.2% are self-employed, 32.4% are civil/public service employees while 26.1% are private sector employees. Due to COVID-19 crisis, 58.2% of respondents indicated a reduced level of productivity while less than 10% were able to maintain or increase their level of productivity (Figure 1). Meanwhile, 71.3% of the respondents reported a reduction in income due to COVID-19 pandemic (Figure 2).

3.2 Correlation analysis of the study variables

Results in Table 3 show the correlation between the study variables. None of the variables is highly correlated suggesting possible absence of collinearity. The highest correlated value exists between the variables of employment before and during the COVID-19 pandemic with correlation coefficient of 0.601. To further examine collinearity, variance inflation factor (VIF) test was conducted (Table 4). The VIF values of the independent variables range between 1.01 and 1.62 with a mean VIF value of 1.24. The absence of collinearity is assumed if VIF values fall below 10. Furthermore, the results of the reliability tests based on Cronbach's Alpha test indicate a high level of internal consistency with a scale reliability coefficient of 0.821.

Table 3: Correlation between the study variables.

	X1	X2	X3	X4	X5	X6	X7
Income (Covid-19) -X1	1.00						
Product(Covid-19)-X2	0.40	1.00					
Age-X3	0.07	0.04	1.00				
Gender-X4	-0.07	-0.04	-0.02	1.00			
Education-X5	0.07	0.12	-0.01	-0.04	1.000		
Employ (before Covid-19)-X6	-0.05	-0.034	0.05	0.16	-0.17	1.00	
Employ(During Covid-19)-X7	-0.07	-0.133	0.041	0.04	-0.26	0.60	1.00

Source: Data Analysis, 2020

Table 4: Variance Inflation factor (VIF) of the variables.

Variables	VIF	1/VIF
Productivity	1.03	0.967
Employment (Before COVID-19)	1.62	0.616
Employment(During COVID-19)	1.67	0.599
Age	1.01	0.994
Gender	1.04	0.966
Education	1.08	0.923
Mean VIF	1.24	

Source: Data Analysis, 2020

3.3 COVID-19, income and productivity

The results of Hierarchical regression analysis for the data is presented in Table 5. Two models are specified for analysis. In the first model, socioeconomic factors of age,

gender and education are regressed alongside productivity and employment status during COVID-19 pandemic. In the second model, the interaction effect of socio-economic variables and productivity are included. The model summary indicates appropriateness of the specification. In the first model, R^2 is 0.167 indicating that the included variables explained about 17% of income variation during COVID-19. However, the diagnostics results of the specification indicated by the significance of F-value show the fit of the model (18.70 (5, 461), $p<0.05$)). In the second model which includes interaction effect, there is R^2 of 0.320 indicating and improvement in the specification. The improved R^2 value shows that the variables account for 32% of the variation in income during the COVID-19 pandemic. Furthermore, the change in value of R^2 indicates that the interaction variables included in the model explain an additional 15.2% of the variation in income generated during COVID-19 pandemic. Significant improvement (5%) in F-value is also observed which lends credence to appropriate specification of the hierarchical regression model.

Table 5: Hierarchical Regression Models of COVID-19, income and productivity.

	Model 1		Model 2	
	Coef.	t-value	Coef.	t-value
Age	0.008	1.34	0.011	1.03
Gender	- 0.169	-1.21	0.130	0.59
Education	0.021	0.41	0.026	0.55
Employment status	- 0.116	-0.70	- 0.046	- 0.18
Productivity	0.319	9.17*	0.604	3.39*
Age x income			0.010	9.80*
Age x productivity			- 0.004	- 1.41
Employ x productivity			- 0.046	- 0.54
Gender x productivity			- 0.073	- 1.01
Constant	0.817	1.86*	0.111	0.18
Total R^2	0.167		0.3201	
R^2 Change			0.152	
F-stat	18.70 (5,461)		23.91 (9, 457)	
F(df) change			25.466 (4,457)	
P-value	<0.001		<0.001	

Source: Data Analysis 2020; *significant at 5%

The results show that significant changes in income generation during COVID-19 could be attributed to changes in the level of productivity ($\beta = 0.604$, $t = 3.39$, $p<0.05$) brought about by COVID-19 pandemic. Age variable could indicate activeness (or otherwise) of individuals, and the capacity to work and earn a living. The interaction of age and income indicates capacity of individuals to earn income despite limited restriction imposed to manage the COVID-19 pandemic. The interacted variable of age and income is positive and significant ($\beta = 0.010$, $t = 9.80$, $p<0.05$) related to income. The positive sign indicates that the capacity to attain higher income level during the COVID-19 depends on age, an indication of capacity to earn income. By implication, only individuals in the active age bracket are able to eke out a living during health

crisis. Intuitively, an aging population may find it difficult to survive COVID-19 consequence.

3.4 Stepwise regression estimates of COVID-19, income, and productivity

Further analysis using a stepwise regression method was conducted to control multicollinearity and identify the most relevant variables influencing income and productivity during COVID-19. All the variables in the hierarchical regression are also included but some were excluded in the stepwise model. Consequently, four models are estimated. The R^2 change of the final fourth model was 0.001 indicating that it was the best model. The resultant model (Model 4) shows an R^2 value of 0.880 (Table 6). This suggests that the included variables account for 88% of the variations in income-productivity nexus due to the pandemic. The Durbin-Watson value is also approximately 2 implying that the specification is appropriate.

Table 6: Model summary of the stepwise regression.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Durbin-Watson
1	0.910	0.828	0.828	2.763	0.828	
2	0.936	0.877	0.876	2.342	0.049	
3	0.937	0.879	0.878	2.326	0.002	
4	0.938	0.880	0.879	2.318	0.001	1.796

Source: Data Analysis, 2023

Table 7: Coefficient estimate of COVID-19, income, and productivity.

Model	β	Std. Error
Constant	5.536	0.662***
Age x income	0.097	0.002***
Age	- 0.159	0.012***
Marital (status)	0.617	0.228***
Gender x productivity	- 0.088	0.043**

Significant at 1% (***) and 5% (**); Source: Data Analysis, 2023

Table 7 shows the coefficient estimates from the stepwise regression model. The results show that all the included variables are significant ($P<0.05$). The coefficient of age is negative ($\beta = -0.159$, $p<0.05$) indicating younger and able-bodied people are more affected by the consequences of the pandemic. The younger the people are, in a pandemic like COVID-19, the higher the possibility of income-productivity challenge. The interaction of this variable of age with income further shows the significant influence of age and income earnings in health crisis period. The findings align with the findings of Adeyemo *et al.* (2021). The parameter estimate of 'marital' status is positive and significant ($\beta = 0.617$, $p<0.05$). The associated positive sign indicates that people who are married in a pandemic are more likely to be overwhelmed during pandemic. This is more specific to their income earnings and productivity levels. The

interaction of gender and productivity also indicates the negative consequence of the pandemic of female relative to male.

5 Conclusions

The study carefully investigated the nexus between COVID-19 income change and productivity in Nigeria. This work adds to the pandemic literature by analyzing the consequence of COVID-19 on income-productivity in an African nation. To the best of our knowledge, this study provides a lead in the research focus on COVID-19, income and productivity in Africa. The findings may be useful to other developing nations. Sequel to our investigation, the findings establish that there was an income change as a result of COVID-19 and social economic factors such as age, gender and education had an important role to play in determining variation in income during COVID-19 lockdown in the area. It also highlighted the effects of the pandemic on productivity capacity of young people. This further provides information on the relevance of microeconomic analysis to formulation of policy relating to pandemic. Productivity, which is the main independent variable nosedived during the lockdown period having statistical significance on the COVID-19 income change. Thus, it is logical to accept that COVID-19 brought about negative change income as a result of change in productivity level. Consequently, this has an implication for poverty in the country. Given this conclusion, the study recommends that there is a need for gradual easing of the economy to prevent further negative change in income due to lower productivity in the country. This would help to prevent worsening of the poverty situation in the country. Also, more attention should be given to the older people who are more likely to experience a substantial drift in their income during a lockdown period.

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