



Macroeconomic Outcomes of Healthcare Financing Reforms in Nigeria: A Computable General Equilibrium Analysis



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Abstract: Since Nigeria's independence, concerted efforts have been made to fortify the healthcare system, aiming to safeguard millions of lives through enhanced primary, secondary, and tertiary healthcare services, and to progress towards universal healthcare coverage, as envisaged by the National Health Act (NHA). Despite the successful adoption of numerous initiatives, they have encountered substantial challenges in implementation and sustainability, influenced by factors such as importation dynamics, price fluctuations from both private and public sources, the impact of subsidy removal, and taxation policies. This study investigates the macroeconomic consequences of potential healthcare financing reforms in Nigeria, particularly focusing on aspects of pricing, taxation, and the import-export balance. Utilizing a Computable general equilibrium (CGE) approach, this analysis draws upon the 2011 Nigeria Input-Output Table to construct a Social Accounting Matrix (SAM). The data is subsequently integrated into the GAMS software, as detailed in the appendix. Findings indicate a disparity between domestic healthcare demand and supply, potentially inciting increased healthcare importation. Crucially, it is observed that escalated taxation on corporations and households exacerbates healthcare accessibility challenges, primarily due to diminished affordability. This research underscores the imperative of recalibrating healthcare financing strategies to mitigate inequalities and enhance service availability, thereby fostering a more robust healthcare system in Nigeria.

Keywords: Healthcare financing reform; Computable general equilibrium (CGE); Nigeria healthcare system; Economic policy impact; Taxation and healthcare access

JEL Classification: D58

1. Introduction

Health reform in Nigeria refers to the rebuilding of its healthcare system and constantly reviewing the use of the NHA. Health reform includes addressing the increase in the financial costs of national healthcare for individuals, families, and the government. It also addresses the benefits citizens receive from the service and how citizens obtain health insurance (Dixon et al., 2004). The goal of health reform is to reduce the number of uninsured individuals, families, and governments, make sure that healthcare is more affordable for citizens, and improve the quality of healthcare service across the nation. In the aspect of global health, healthcare reforms that take place in health systems across the world vary depending on various factors within the nation. Such factors that drive health reform in each country depend on the economy of the country, average per capita income expenses on healthcare, financial costs and expenditures, insurance industry structure, government support for healthcare coverage, research, and development. This initiative is progressing towards universal health coverage, which requires a concerted effort to strengthen the health system (Hsiao et al., 2011).

Computational general equilibrium is a numerical method that combines economic theory with real economic data in order to derive the computational impacts of policies or shocks in the economy. This provides a framework to simulate policy changes and trace their impact on key economic variables, including income, that capture the

structure of the economy and the behavioral responses of agents (firms, households, the government, etc.). (Partridge & Rickman, 2010), the purpose for which we used CGE analysis is because computational general equilibrium provides an indicator for a sector that is not efficient and the implication for other sectors.

Nigeria is among the countries with a large number of maternity and under-5 deaths, and it is not on track to achieve the objectives of the key health Sustainable Development Goals (Ogbuonji & Yamey, 2019). Health outcomes in Nigeria are weak, not just in absolute terms but also when compared to other countries with similar income per capita (Abubakar et al., 2022). Nigeria is among the world's largest producers of oil, with a position of 13th in the world (among the largest oil producers in the world), while the country is spending less on healthcare as per GDP, which is the second lowest in the world (Tulloch et al., 2017).

In addressing these challenges, Nigerian policymakers have put forward important health initiatives over the past decade, including the National Health Act, large-scale primary healthcare (PHC) programs such as the Saving One Million Lives (SOML) program, the National Health Insurance Authority Bill of 2022, and other major reforms (Abubakar et al., 2022; Khan, 1995).

The study shows that there has been recent interest in the household-level economic impacts of illness and out-of-pocket expenditure on healthcare in Nigeria (Włodarczyk, 1993). We also realized that payment for healthcare at public facilities relies on private, for-profit providers, for whose services there are frequently direct payments, which constitute a major financial burden on households (OECD, 2010). When combined with the costs of being unable to carry out normal activities due to illness, such as daily work, this has consequences for the families that lead them to poverty or are being pushed to poverty. There is also a rapid increase in international advocacy to remove the fees for primary healthcare, particularly from the British government's foreign aid organization, the Department for International Development (DfID) (Hsiao et al., 2011), which proposes with various African governments to remove primary healthcare fees, calling for free access to quality basic health services for all. A lot of households use private health providers due to the poor quality of public-funded services, such as the unavailability of essential medicines, laboratory facilities, and drugs at public healthcare services. In order to gain quick access to healthcare (McIntyre et al., 2006), some efforts have been made at the national and international level on the financing of primary healthcare (PHC) in national health systems in terms of expanding access and ensuring equity (Silva et al., 2022). Some of their findings are that there is not a single possible financing model; it depends on the region in which you find yourself (Tendler & Freedheim, 1994).

These models seek to investigate the reason for urge importation of health, growth rate in the GDP, private and public consumption, investment demand, price dynamics through the taxation across the different sector most especially on the healthcare which you will find detail in our research findings, we used social accounting matrix to display the expenses of the country by dividing all the sector into three Health, Manufacturer and Other which show the distribution across the sectors, it also display the amount of health import, export, the tax collected from both domestic and importation, the subsidies pay by government across the sector, the firm contribution across the sectors, the consumption of fixed income by citizens, contribution of Rest of the world. We convert the social accounting matrix to a compartmental model to explain more about the formulation and conceptualization of our model. The compartmental model explains the same scenario as the social accounting matrix, with intermediate consumption, industry demand and consumption, household consumption, and demand by different sectors, including taxes.

We visualized our social accounting matrix for us to view the picture of our social accounting matrix before the simulation in the absence of tax and price in order to understand the basic background of the model. At the end, we simulate the social accounting matrix using some equations in the appendix to run our model together with GAMS software so that we can visualize the graphs and analyze the model. We run the model from 25% to 125% in order to see the prices, demand, and consumption dynamics under different tax assumptions. And notice that the more the tax goes up, the more the price of importation increases, but exportation and demand remain constant while supply and consumption decrease. In addition, we find out that the more the government increases the tax on both the company and the household, the more the household is far from accessing quality healthcare due to their inability to pay for the service.

2. Preliminary Analysis

Before the Social Accounting Matrix, the data to be used were reviewed and collected from the Nigeria National Bureau of Statistics office (NBS, 2011) called NBS in Abuja, where we collected the 2011 input-output table of Nigeria (see Table A1, Table A2, Table A3, Table A4, Table A5, Table A6, Table A7 and Table A8 in Appendix for detail), which consists of 34 sectors and was further segmented into three sectors: health, manufacturing (MAN), and other (OT). Our interest is particularly in health finance (income and expenditure) and comparing health (income and expenditure) with Nigerian manufacturing companies and firms such as banking, services, etc. From the Nigeria 2011 I/O Table, we formulate the Social Accounting Matrix from the table, which minimized and displayed complete Nigerian expenditures in 2011. The data was granted without any limitation.

2.1 Social Accounting Matrix (SAM) Description

This section describes the income and expenditure of Nigeria in 2011. In the table, we are only interested in health expenditure and income after formulating our SAM and comparing it with other sectors. We computed our SAM with the 2011 I/O Table and found that in the 2011 input and output table, the health demand is about 23,371.30 in Nigeria (see Table A1, Table A2, Table A3, Table A4, Table A5, Table A6, Table A7 and Table A8 in Appendix for detail), but only 2,931,619.46 are produced in Nigeria and imports are 320,440,061.79 (Table 1, Table 2, and Table 3). Adding the two numerals, we have 323371681.25, which we assumed was an error in the Nigerian calculation of health demand. The difference is a huge amount of money. Using statistics, we derived that only 0.91% of health products are produced in Nigeria and 99.09% are imported from outside the country. From the SAM, we notice that the amount spent on health by Nigeria is approximately 0.79% of the total production of all Nigerian companies (see Table 1, Table 2, and Table 3), and the health subsidies are zero for the health sector, while manufacturing (MAN) and other (OT) subsidies are approximately 238034081.70 and 2722.95, respectively. The result shows that part of what may be causing a lot of problems for health is that the health sector is not subsidies, while other sectors are. This may be part of the issue Nigerians are facing in accessing good health conditions due to health being expensive, in which we are encouraging the government to be able to subsidize the health of their citizens for less privilege to be able to access good health. This also bridges the gaps in inequality in the health sector. Despite that, looking at the data, we realize that a lot of Nigerians are selling their property (consumption of fixed income) in order to pay for their health service, which is an out-of-pocket payment, while the remaining money is spent on manufacturing and other sectors.

Again, looking at the data (SAM), the total tax gain on importation health is around 296075682.33 which is very huge amount of money and almost equal to Health domestics production 2931619.46, this can also cause the citizen not to have access to good health because of tax imposed on health importation together with exchange rate, the implicate of the tax on health at both domestic and at world market is that the more tax is imposed on health, the more citizens we not be able to paid for the service at a particular point were citizens need to be directed to international for proper healthcare in a case when the service is not available at the domestic level some citizens may find it difficult to paid for the bills and health right may be denied due to bills, taxies and exchange rate at international level. We also critically compared the importation service charge with the government tax charge at the importation level and found out that the service charge is around 2931619.46 while the tax charge by the government is 296075682.33. This means that the amount they tax Nigerians on health imports is even more than the health service received by the patient. We did the same thing with manufacturing and other sectors. When we added up the taxes on manufacturing and other sectors (3186842.27+18987.64) and compared them to the health tax (296075682.33), we saw that the health tax was still higher than the two sectors combined.

Part of the sector that is supposed to reduce the financial cost of health expenditure to citizens is enrolling them in an insurance scheme, which is insurance firms. Due to the government, some insurance is compulsory for citizens, and we also have some private insurance in which candidates can enroll willingly, but looking at the contribution of firms to domestic health, which was approximated to be 30567.93 out of 2931619.46, is very small. Looking at the figure in terms of percentage, it was calculated to be 1.04% of domestic health services. The percentage shows that firms and insurance contribute approximately 1% to health, which is very low. We can deduce from the percentage that the insurance sector has a low turn-up in terms of enrollment compared to the total population. And at the aggregate level, it is not even significant.

Table 1. Part 1 of SAM

	LD	KD	CFC	SAL	CAP	Firms	GOVT
LD	0	0	0	0	0	0	0
KD	0	0	0	0	0	0	0
CFC	0	3794288.513	0	0	0	0	0
SAL	166875641.6	0	0	0	0	0	0
CAP	0	127742800	0	0	0	15597.624	0
Firms	0	1706971.306	0	0	0	629706.696	0
GOVT	0	0	0	7521598.486	36684930	39527.56	0
Subsidies	0	0	0	0	0	0	238036804.7
INDTax	0	0	0	0	0	0	0
ROW	0	0	0	0	0	0	0
HEALTH	0	0	0	0	0	0	0
MAN	0	0	0	0	0	0	0
OT	0	0	0	0	0	0	0
HEALTH	0	0	1242.586	700887.269	2297869.994	0	646191.555
MAN	0	0	3788862	157659511	83513035.58	11879.919	40633255.75
OT	0	0	4184.359	993644.735	5262562.05	8074.218	2684435.33
HEALTH	0	0	0	0	0	0	0

MAN	0	0	0	0	0	0	14964075.56
OT	0	0	0	0	0	0	
ACC	0	0	0	0	0	31592832.48	61526881
TOTAL	166875641.6	133244059.8	3794289	166875641.5	127758397.6	32297618.5	358491643.9

Table 2. Part 2 of SAM

	INDTax	ROW	HEALTH	MAN	OT	HEALTH	MAN
LD	0	0	79933.18	164086400	2709308.375	0	0
KD	0	0	2766210	87215950	43261900	0	0
CFC	0	0	0	0	0	0	0
SAL	0	0	0	0	0	0	0
CAP	0	0	0	0	0	0	0
Firms	0	0	30567.93	318502.088	29611870.48	0	0
GOVT	314245587.8	0	0	0	0	0	0
Subsidies	0	0	0	0	0	0	0
INDTax	0	0	0	0	0	296075682.3	3186842.271
ROW	0	0	0	0	0	21432760	270520471.7
HEALTH	0	0	0	0	0	2931619.46	0
MAN	0	0	0	0	0	0	64813000
OT	0	0	0	0	0	0	0
HEALTH	0	0	47024.29	0	287141839	0	0
MAN	0	0	-0.002	111173300	1007762.575	0	0
OT	0	0	7884.243	1300375.513	61885.891	0	0
HEALTH	0	0	0	0	0	0	0
MAN	0	299281512.2	0	0	0	0	0
OT	0	0	0	0	0	0	0
ACC	0	0	0	-15.4	-360808377.9	0	299281512.2
TOTAL	314245587.8	299281512.2	2931619	364094512.2	2986188.422	320440061.8	637801826.2

Table 3. Part 3 of SAM

	OT	HEALTH	MAN	OT	ACC	TOTAL
LD	0	0	0	0	0	166875641.6
KD	0	0	0	0	0	133244059.8
CFC	0	0	0	0	0	3794288.513
SAL	0	0	0	0	0	166875641.6
CAP	0	0	0	0	0	127758397.6
Firms	0	0	0	0	0	32297618.5
GOVT	0	0	0	0	0	358491643.9
Subsidies	0	0	0	0	0	238036804.7
INDTax	18987.643	0	14964075.61	0	0	314245587.9
ROW	7328280.52	0	0	0	0	299281512.2
HEALTH	0	0	0	0	0	2931619.46
MAN	0	0	299281512.2	0	0	364094512.2
OT	2986188.43	0	0	0	0	2986188.426
HEALTH	0	0	0	0	29605007.2	320440061.8
MAN	0	0	0	0	1980138.02	637801826.1
OT	0	0	0	0	7687.297	10333456.59
HEALTH	0	0	0	0	0	0
MAN	0	0	0	0	0	314245587.8
OT	0	0	0	0	0	0
ACC	0	0	0	0	0	31592832.41
TOTAL	10333456.6	0	314245587.8	0	31592832.5	

2.2 Compartmental Model Description

Figure 1 shows how each sector is receiving from each other as it was shown in the Social Accounting Matrix with primary labour and capital and consumption of fixed income, the social accounting matrix was transform to Model for people who don't have the knowledge of SAM to able to grape the concept we start the model by considering the LB_j who received a salary as their return for labour, seeing further the data display the distribution of it fund across the sectors (Health, Man, OT) including intermediate consumption in the SAM and C_{ij} in compartmental Model with government tax and KD_j who received from Capital, firms, Consumption of Fixed Income that's individual who sell their property to paid for Health, Man and Other. The firm (YHF_j) invested in capital, paid taxes, and saved the rest of the money. The government (YG_j) does the national budget by paying to

G, which includes subsidies and some intermediate government demand, Investment (INV), and saving the remaining funds for future use.

Value added (VA_j) contributes to exportation (EX_j), which leads exportation to pay her tax (TE_j), the tax is coming back to the government (YG_j), domestic market (X_j) received from the supply (DS_j) and intermediate consumption (CI_j), and the intermediate consumption gave to intermediate demand (DI_j), where quantity supply received the good from intermediate demand (DI_j), demand (DD_j), and total investment (TI). In addition, every salary-earner payment receiver (YH_{sal}) also paid tax to the government. After paying tax, there was no saving record from the household, which indicates that some households (YH_h) did not save for that period of time. The government paid subsidies for his people. As you can see, government savings are positive, which is unusual, but in most of the given SAM, most of the government saving in the balance sheet is always negative due to debt incurred by the government in or before the budget, but in our own, the government saving is positive due to our I/O table didn't revealing the government external debt or current debt at that particular time. If we assume we know the government deficit, then we will add it to saving, which may yield a deficit to the government balance in our SAM. The labor (LB_j) plus capital (KD_j) become value added, which is part of domestic production. Intermediate consumption, exportation (EX_j), and importation (IM_j), whose tax was recorded as part of government revenue (YG_j), importation (IM_j), and quantity demand (DD_j) yield quantity supply, where exportation (EX_j) and quantity supply (DS_j) got their goods from domestic production (XS_j).

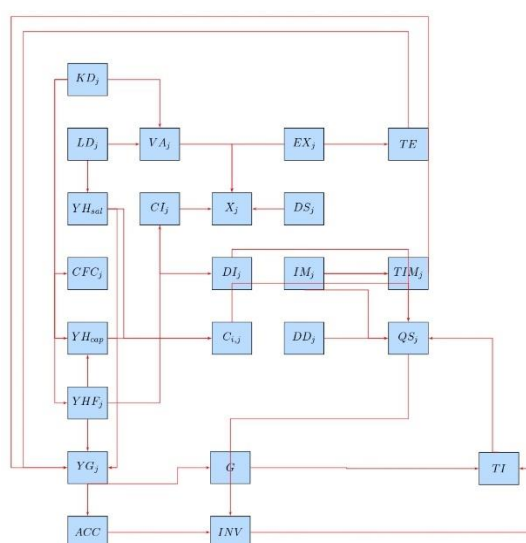


Figure 1. Compartmental model

3. Basic Data Analysis

3.1 The Sectoral Value Added

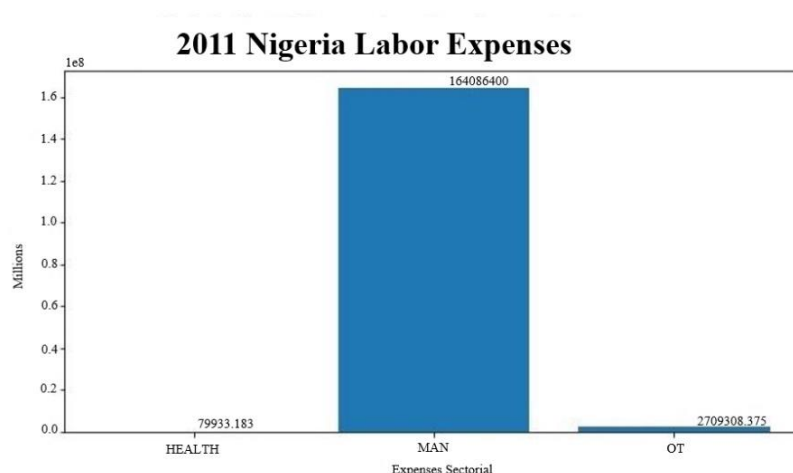


Figure 2. Labor expenses

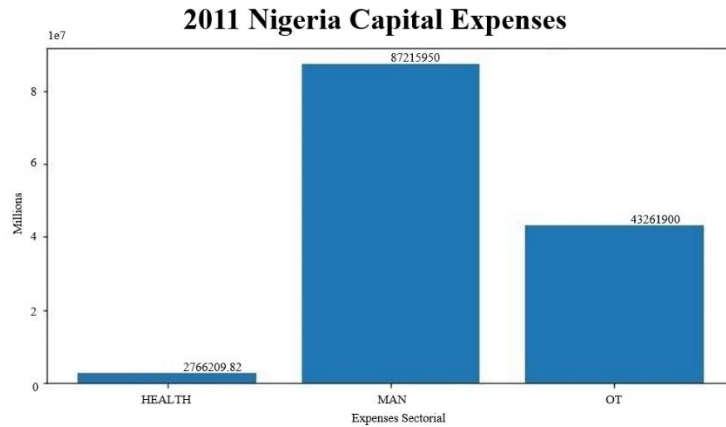


Figure 3. Capital expenses

Looking at Figure 2 and Figure 3, we can see that both health labor and capital expenses are less than in other sectors where the value added of health, man, and OT is 28461, 251302350, and 45971208.38, respectively. Value-added for Health, Man, and OT provides an important entry point for development support, including increased income, employment creation, improved safety, and security. It also helps to identify whether the institute is more effective or less effective, as well as the areas in which it is differentially effective. From the figure, we can deduce that the amount paid to the health worker is very low compared to other sectors, and similarly, the investments in health are also very low compared to other sectors, which can yield low health turn-up for both the worker and the receivers.

3.2 Household Demand, Consumption and Expenses

Figure 4 shows the quantity of demand by households in different sectors. Despite the low quantity of demand by households compared to other sectors, the government fails to meet their demand. Figure 5 shows the consumption of households and the amount paid to households, but the question is: do people not have an orientation to invest? Because labor is higher than capital, which means consumption is higher than production, this means a low level of production or investment and a higher level of consumption. Looking further, the capital is almost half of the labor, which explains why people didn't invest, maybe due to their dependence. We need to look at this at the micro-level. Figure 6 shows the total amount of money spent on households for both capital and salary. A critical thought occurs: despite the salary, a lot of people are still selling their property to pay for something (health, man, or other). What could be the problem with the household? This can yield another investigation in the future.

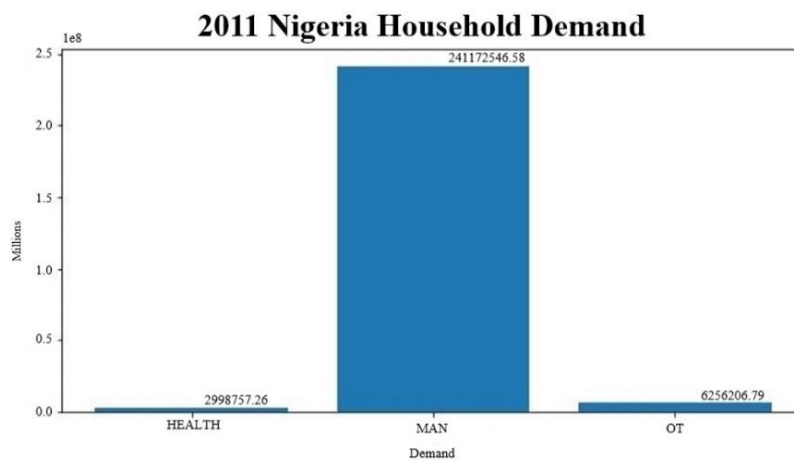


Figure 4. Household demand

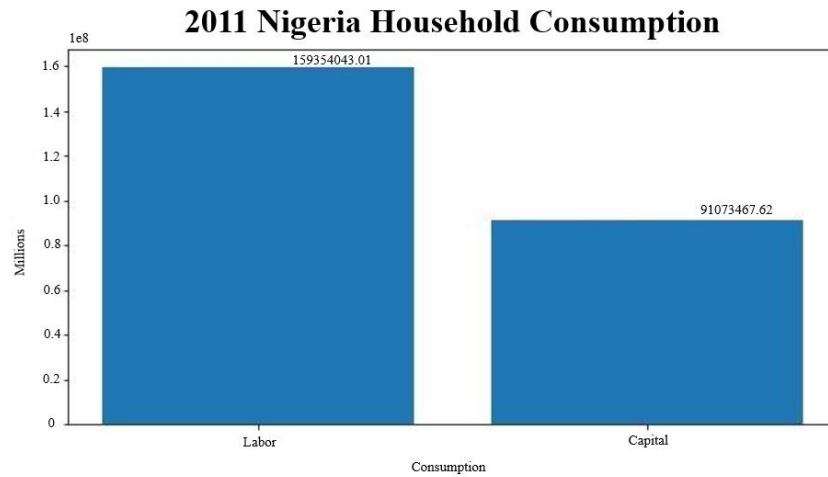


Figure 5. Household consumption

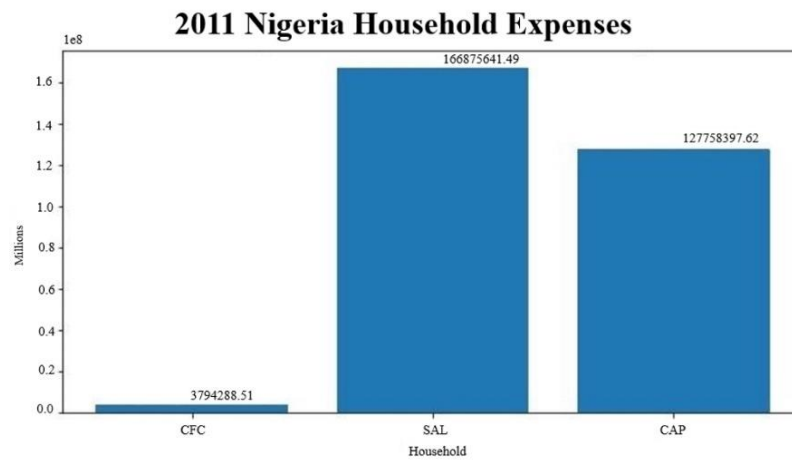


Figure 6. Household expenses

3.3 Intermediate Demand

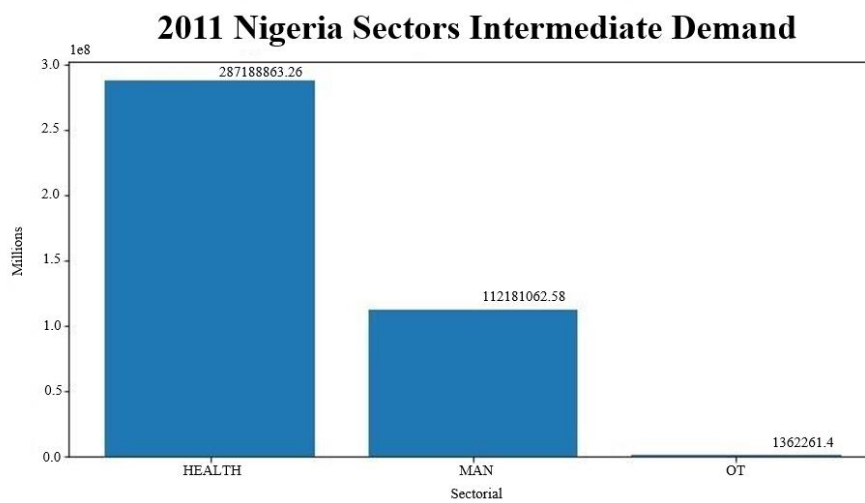


Figure 7. Intermediate demand

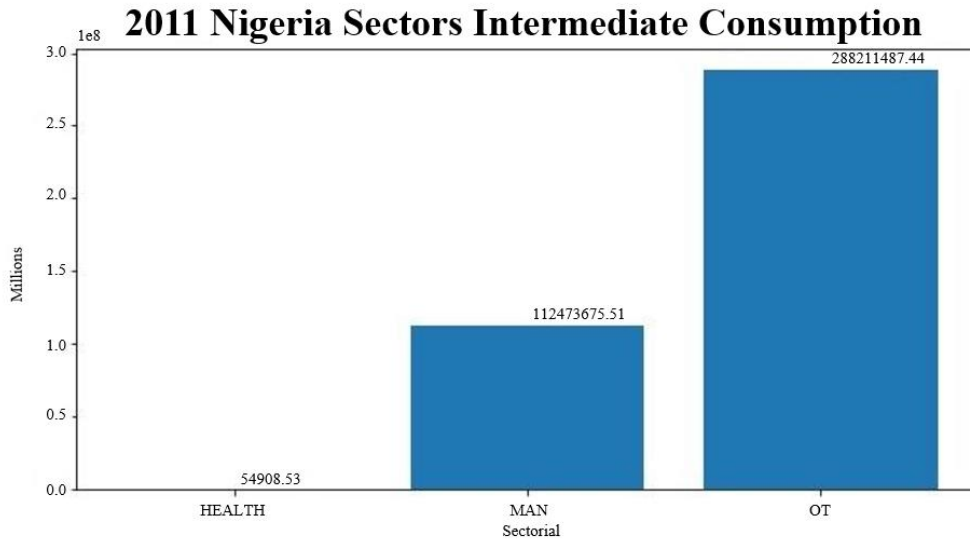


Figure 8. Intermediate consumption

Figure 7 and Figure 8 show sectoral intermediate demand and consumption. The intermediate demand for health is very high, but the supply is very low. This means there is more demand for health than supply, which can be the reason for the importation of health. Second, the health sector requires more demand, followed by the manufacturers and then other sectors. But the surprise is that in terms of distribution and consumption, health sectors come last, followed by manufacturers and other sectors, which are leading in domestic consumption. This brings to light the fact that for the health sector to fill the gaps, they need to import health from outside the country, but what are the scenarios in which other sectors receive more money that is not requested than health and manufacturers? This needs to be investigated in the future.

3.4 Investment Demand

Figure 9 and Figure 10 show again that the health sector requires more investment than other sectors, which is equivalent to what we explained previously in terms of health demand. Figure 10 shows the basic market GDP of the sector; this is calculated by adding (health labor + health capital) + (man labor + man capital) + (OT labor + OT capital), while market price is calculated by adding taxes to the basic price GDP.

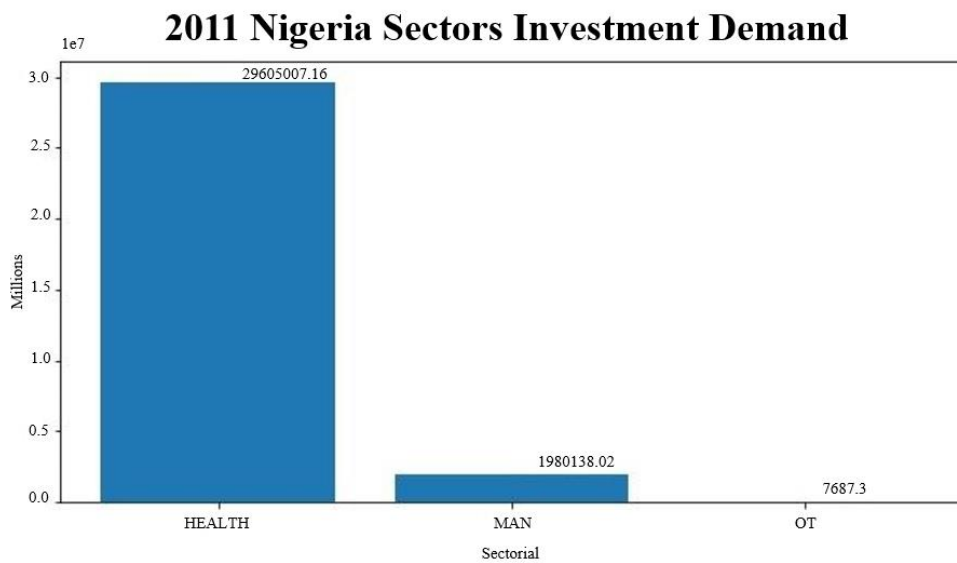


Figure 9. Investment demand

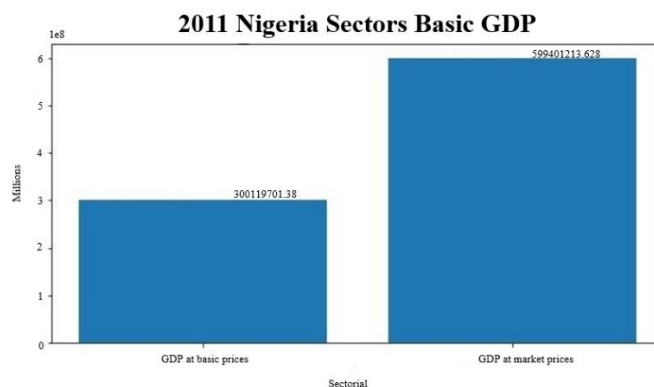


Figure 10. GDP

3.5 Importation and Exportation

Figure 11 and Figure 12 show the importation of health products to Nigeria, which is almost half of the manufacturing sector. The amount of health imported is even greater than the amount of health produced in the country (for details, see Table 1, Table 2, and Table 3), which shows the amount of money spent on health by Nigerians in foreign countries, but we export nothing in terms of healthcare and other sectors. Even in manufacturing, research shows that the exportation indicators are raw materials we are exporting to other countries (Sani, 2009).

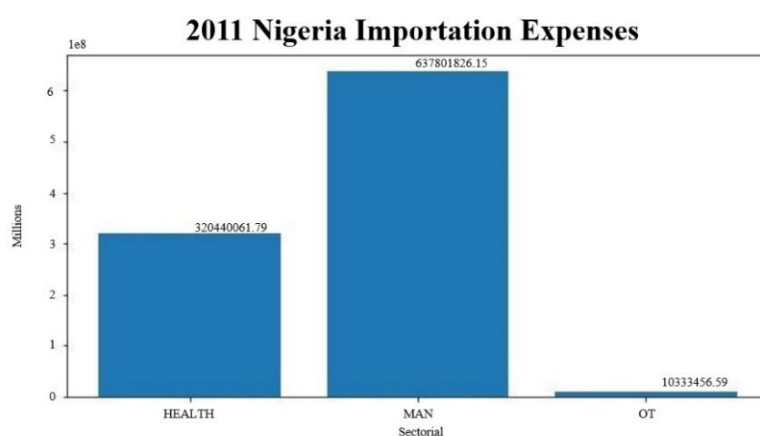


Figure 11. Importation

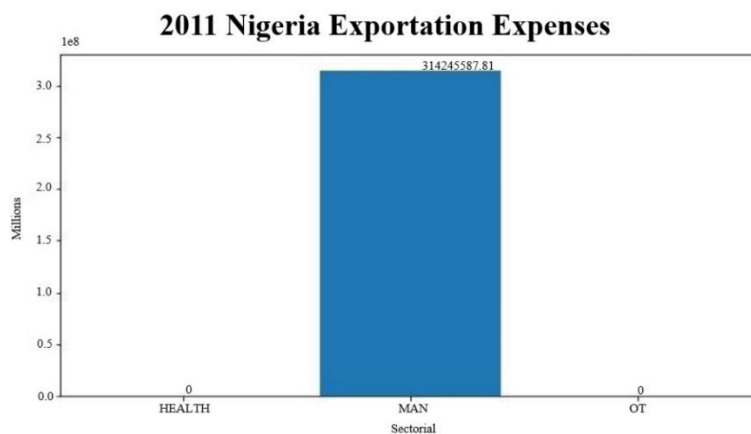


Figure 12. Exportation

4. Simulation and Analysis

Upon examining Figure 13, it is evident that the demand for Other, Manufacturer, and Health did not decrease, except at tax rates of 50% and 100%. However, the demand for other sectors remained unchanged. From an alternative perspective, at a supply level in Figure 14, it is evident that the supply for manufacturers exhibits a wide range of variation throughout, whilst the supply for health and other services remains consistently varied at 50% and 100% respectively. For the remaining portions, the appearance remains consistent at 25%, 50%, 100%, and 125%, but it differs at 75% and 150%.

In Figure 15 and Figure 16, we find that in terms of people requested, demand is not equivalent to supply; health demand is steady why the supply is not; likewise, manufacturing demand is somehow steady while the supply is not; for OT, demand is somehow fluctuating why the supply is low compared to demand for the section; in general, this figure shows that the demand for health, man, and OT are not equal to supply, which may motivate the citizen to go for additional importation.

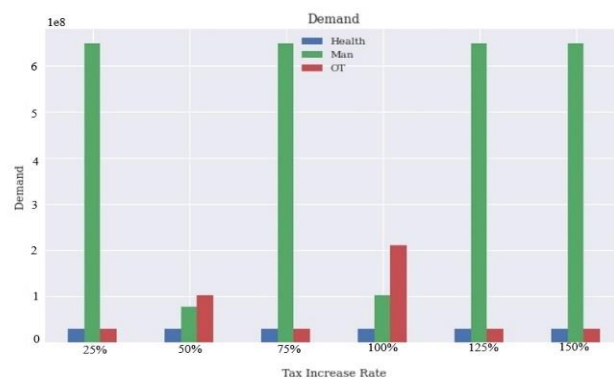


Figure 13. Demand

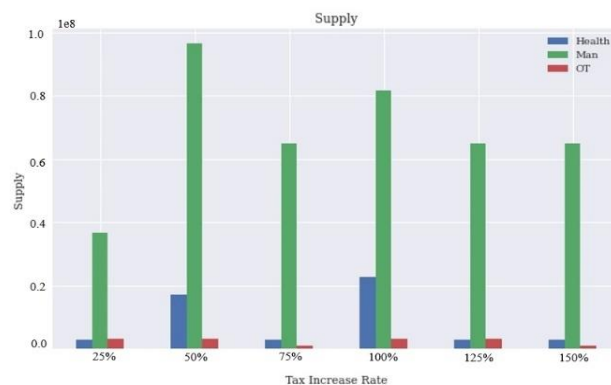


Figure 14. Supply

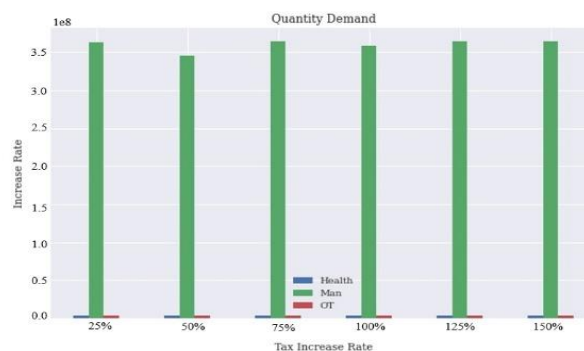


Figure 15. Quantity demand

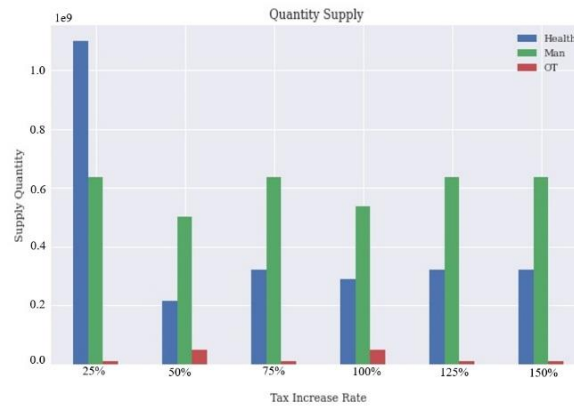


Figure 16. Quantity supply

Based on Figure 17 and Figure 18, it is evident that the importation price had a consistent rise across most sectors, with the exception of manufacturers, due to the tax hike. Conversely, the exportation price remained unchanged. This demonstrates that there is a direct correlation between the increase in taxes and the corresponding rise in import prices, while export prices remain unaffected. This implies that our product may not be well regarded in the global market, although their product may be highly regarded in our country. Furthermore, the rise in domestic taxes has no impact on the price in the global market, since the indication has not altered the price at the global market.

Compared to Figure 19 and Figure 20, it is clearly shown that health importation consumes a lot of tax, and the tax received from health by foreigners is greater than the tax of both the manufacturer and other sectors in Figure 19. This can be due to accommodation, flights, and other expensive charges together with tax at that particular moment, but for the exportation, the tax was high at the beginning and became stable at the end.



Figure 17. Importation price

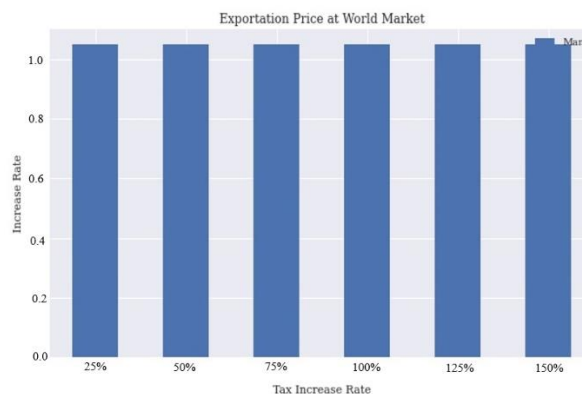


Figure 18. Exportation price

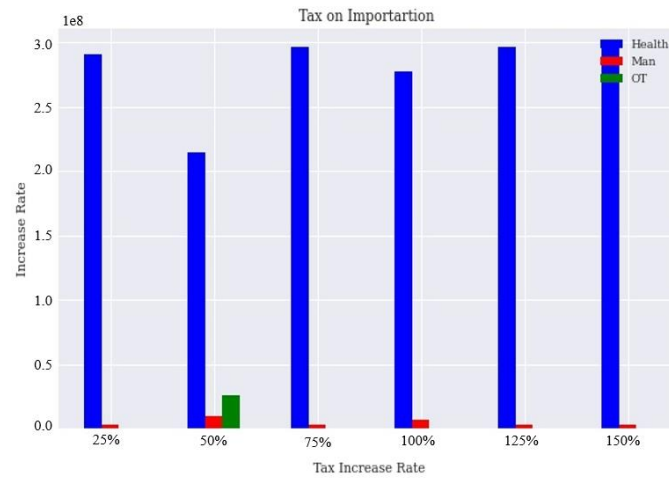


Figure 19. Importation tax

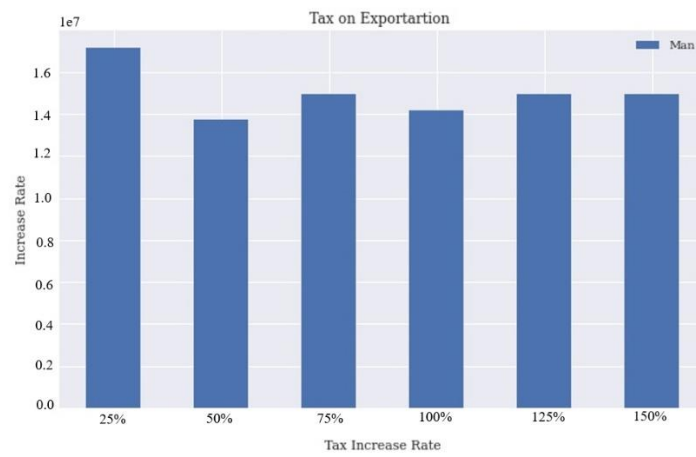


Figure 20. Exportation tax

Figure 21 shows the intermediate demand and consumption. We can see that as tax increases, health demand across the sectors is fluctuating, which becomes stable at the maximum tax increment, followed by manufacturing, which is stable. Stability may be insured by the government for all the companies to avoid inflation. Figure 22 shows that consumption of OT is decreasing and MAN is still stable, while health consumption is invisible in the figure.

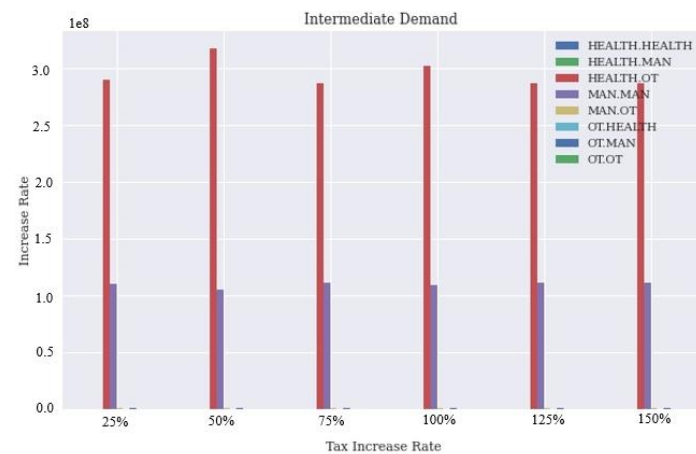


Figure 21. Intermediate demand

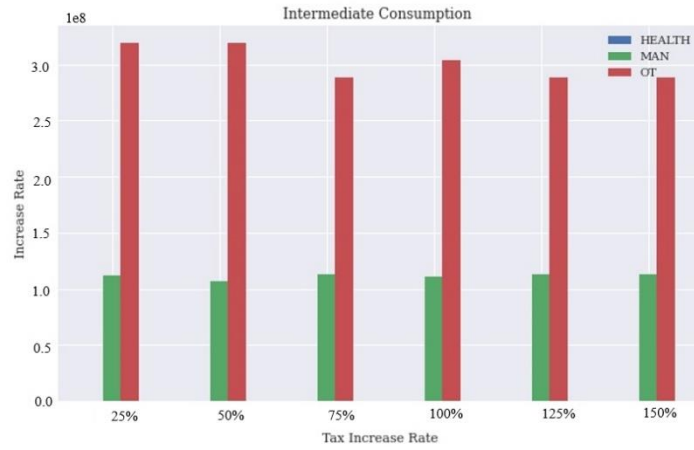


Figure 22. Intermediate consumption

Looking at Figure 23, we can deduce that the total intermediate demand is fluctuating for the health sector, while the manufacturing sector is stable throughout. The situation is assumed to be the same for OT, despite the fact that the chart is not visible. And for Figure 24, all the sectors are not stable from the beginning to the end.

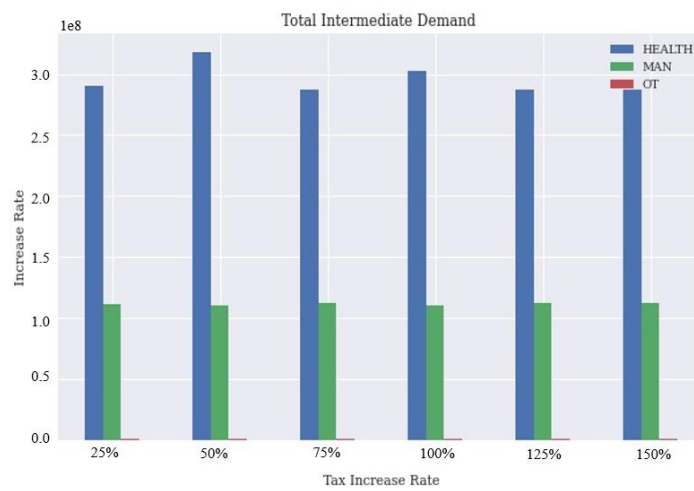


Figure 23. Total intermediate demand

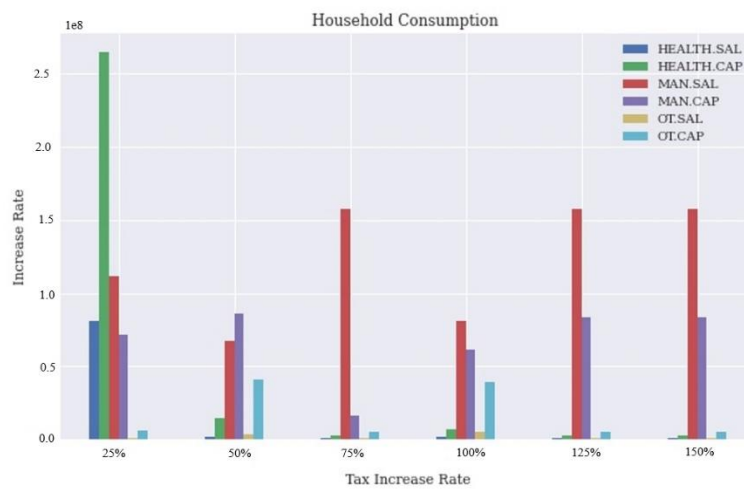


Figure 24. Household consumption

The labor demand in Figure 25 has been changing a little bit as a result of the tax change, but the change is in terms of reduction. Maybe people are being sacked due to the fact that the sector cannot longer pay the service fees while capital demand in Figure 26 remains constant as the tax increases from the government. This is telling us that no matter how the government increases the tax, labor and capital demand may remain the same in each sector.

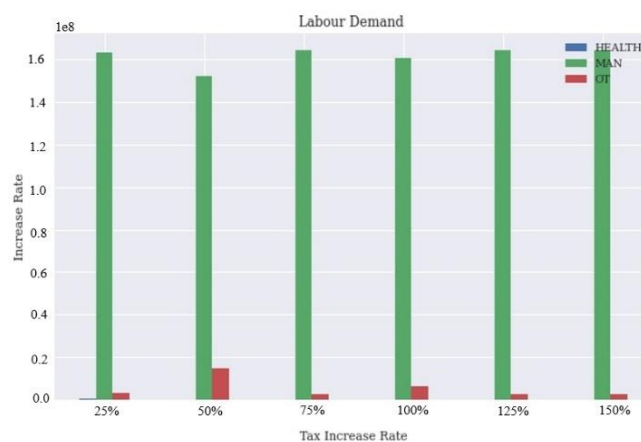


Figure 25. Labour demand

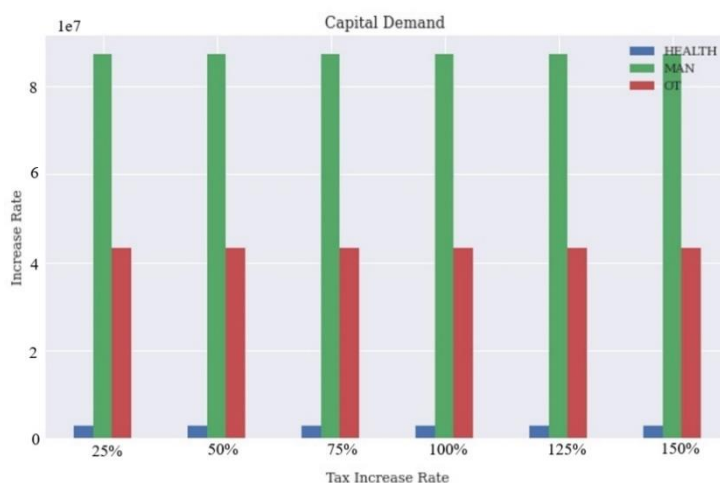


Figure 26. Capital demand

5. Conclusions

Our research indicates that an increase in taxes does not diminish public demand. Rather, it primarily affects market pricing and the supply of services. Regardless of how much the government raises taxes, it does not have the ability to decrease the desired quantity of demand. Furthermore, a tax increase does not impact the global market price. Based on the findings of the previous study, it is evident that the global market remains unaffected by a tax hike. Consequently, our products lack value in the worldwide market. As the government raises taxes, more individuals are unable to afford healthcare at the local level, resulting in limited access to this service. Furthermore, it is evident that the health sector experiences a significantly higher level of imports in comparison to other sectors. This substantial influx of imports has the potential to destabilize the country's economy. The allocation of funds to the healthcare sector falls short of meeting the demand, resulting in significant gaps. Who is responsible for filling the gaps? This gap can be addressed by implementing various initiatives such as public-private partnerships, foreign direct investment, or novel financing structures, which will result in improved healthcare and financial coverage in the country. Furthermore, we engage the government to standardize the taxation levied on the populace in order to prevent a rise in healthcare fees. Subsidies should be implemented to promote equity, and individuals should be incentivized to participate in the insurance program to prevent the depletion of residents' fixed income.

6. Model Recommendation

We suggest that the government should implement regulations on household and corporate taxes to standardize the financial burden of living expenses. It is evident that as taxes increase, prices tend to rise accordingly. Additionally, we recommend that the government strive to provide comprehensive insurance coverage for all citizens, thereby eliminating the need for out-of-pocket payments. Encouraging foreign direct investment in the establishment of various hospitals would reduce the reliance on imported healthcare services, allowing the local currency to circulate within the domestic economy. Exploring alternative innovative financing mechanisms could also be considered. Furthermore, it is crucial to enhance the expertise of our citizens in areas where there are deficiencies, enabling local doctors to treat patients without the need for overseas referrals for healthcare services. The government should provide subsidies for healthcare in order to reduce the per capita cost of healthcare. Additionally, external donors and philanthropists are encouraged to support both private and public sectors in subsidizing healthcare.

Data Availability

The data used to support the research findings are available from the corresponding author upon request.

Acknowledgement

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Conflicts of Interest

The authors declare no conflict of interest.

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Nomenclature

DD(j) Demand for domestic commodity j	KS(j) Capital supply in industry j
DS(j) Supply of commodity tr on the local market	LD(j) Industry j demand for labour
EX Export of commodity	LS Total labour supply
IM(j) Import of commodity j	VA(j) Value added of industry j
Q(j) Demand for composite commodity j	XS(j) Output of industry j
e Nominal exchange rate	P(j) Price of commodity j (excluding tax)
PC(j) Purchase price of composite commodity j	DTF Receipts from direct taxation on firms income
PE Producer price of exported commodity	PCI(j) Intermediate consumption price index of industry j
PVA(j) Price of industry j value added	PD(j) Price of commodity j (including tax)
PL(j) Price of commodity sold on the Local market (excluding tax)	R(j) Rental rate of capital in industry j
PM(j) Price of Importation (including duties and taxes)	W wage rate
PWE World price of exported product tr (in foreign currency)	CTH(h) Consumption budget of type h households
PWM(j) World Price of importation product j (in foreign currency)	DTH(h) Receipts from direct taxation on household h income
TIE Receipts from indirect tax on exported commodity	G(j) Current public expenditures
TIM(j) Receipts from import duties on commodity j	IT Total investment
C(i,h) Consumption of commodity i by type h households	SF Firm Business savings
CI(j) Total intermediate consumption of industry j	io _j Rate of output of Industry j
DI(i,j) Intermediate consumption of commodity i in industry j	SG Government savings
DIT(j) Total intermediate demand for commodity j	SH(h) Saving of type h households
INV(j) Final demand of commodity j for investment purposes	TG Public transfers to salaried households
KD(j) Industry j demand for capital	TI(j) Receipts from indirect tax on commodity j
YH(h) Income of type h households	YDH(h) Disposable income of type h households
YG Government income	YF Business income

Appendix

Table A1. Part 1 of 2011 input-output table of Nigeria

Activity Sector	Crop Production	Livestock	Forestry	Fishing	Crude Petroleum & Natural Gas	Coal Mining
	1	2	3	4	5	6
Crop Production	2715912.683	0	0	0	0	0
Livestock	0	0	0	0	0	0
Forestry	0	0	0	0	0	0
Fishing	0	0	0	0	0	0
Crude Petroleum & Natural Gas	0	0	0	7413.391753	346801.0668	0
Coal Mining	0	0	0	0	0	0
Metal Ores	0	0	0	0	0	0
Other Mining & Quarrying	0	0	0	0	0	0
Oil Refining	147388.0274	0	5720.305215	21319.27157	10993.91159	0
Cement	0	0	0	0	6673.928598	0
Other	563675.6804	543755.094	140233.3522	40839.68876	224536.6313	1.09
Manufacturing						
Electricity	0	0	0	1031.936852	297551.1681	0
Water	0	0	0	278.6780337	208.0676294	0
Building & Construction	0	0	0	44573.43016	150706.2761	0
Road Transport	12000	4000	10291.57725	9185.939825	128024.0044	0

Rail Transport & Pipelines	0	0	0	1.814553611	6.787135418	0
Water Transport	0	0	243.9169815	0	671.2858956	0
Air Transport	0	0	0	0	3102.835256	0
Transport Services	0	0	0	0	3968.581813	0
Tele communications	0	0	0	15657.6612	13193.95779	0
Post	0	0	0	630.3905666	602.0264421	0
Distributive Trade (Wholesale & Retail Trade)	106015.1072	154894.5974	1449.465972	88288.04052	25826.62945	0
Hotels & Restaurants	0	0	0	0	2380.92778	0
Financial Institutions	0	0	1021.003431	41142.27694	28136.78495	0
Insurance	0	0	146.1533922	369.1276332	369.2545103	0
Real Estates	0	0	0	0	155924.5048	0
Business Services (Not Health or Education)	0	0	0	31426.16028	555.3027891	0
Public Administration	0	0	0	0	0	0
Education	0	0	0	0	0	0
Health	0	0	0	0	0	0
Private Non Profit Organisations	0	0	0	0	0	0
Other Services	0	0	256.6333801	2601.418982	0	0
Broadcasting	0	0	1860.314341	0	265.7716275	0
Domestic Intermediate Inputs	3544991.498	702649.6914	161222.7221	304759.2276	1400499.705	1.09
Non Competitive Imports	100000	0	189.0998406	0	266519.5886	0
Total Intermediate Inputs	3644991.498	702649.6914	161411.822	304759.2276	1667019.293	1.09
Compensation of Employee	3224549.878	142437.4572	72379.26683	32713.21671	5406535.823	0.571404313
Consumption of Fixed Capital	42180.00581	338.7835477	40.78555589	914.539227	60563.10209	0.263685202
Operating Surplus	6935277.121	477326.4315	65162.93921	39332.34194	9841214.481	0
Value Added at Current Basic Price	10202007	620102.6722	137582.9916	72960.09787	15308313.41	0.835089514
Indirect Taxes	595.6438748	5964.82	2403.53944	600.7287423	13532.5785	0
Less Subsidies	13466.3079	0	0	0	0	0
Value Added at Current Producer Prices	10189136.34	626067.4922	139986.531	73560.82662	15321845.98	0.835089514
Gross Input	13834127.84	1328717.184	301398.353	378320.0542	16988865.28	1.925089514
Gross Output	13834127.84	1328717.187	301398.3499	378320.0496	16988865.28	1.926806214
	Crop Production	Livestock	Forestry	Fishing	Crude petroleum & Natural Gass	Coal Mining

Table A2. Part 2 of 2011 input-output table of Nigeria

Activity Sector	Metal Ores	Other Mining & Quarrying	Oil Refining	Cement	Other Manufacturing	Electricity
	7	8	9	10	11	20
Crop Production	0.00	0.00	0.00	0.00	774,345.43	0.00
Livestock	0.00	0.00	0.00	0.00	565,085.22	0.00
Forestry	0.00	0.00	0.00	29.01	113,273.19	0.00
Fishing	0.00	0.00	0.00	0.00	2,058.94	0.00
Crude Petroleum & Natural Gas	0.21	935.16	203,159.34	606.91	1,001.30	160,903.58
Coal Mining	0.00	0.00	0.00	0.00	0.00	0.00
Metal Ores	0.08	8.09	0.00	6.59	14.46	0.00
Other Mining & Quarrying	0.05	115.62	0.00	38,532.22	3,535.40	0.00
Oil Refining	0.82	6,165.35	590.06	15,225.41	170,494.17	138.92
Cement	0.10	664.16	0.00	9,015.61	186.89	0.00

Other Manufacturing	14.04	3,743.85	25,104.04	78,213.93	1,626,353.65	101,144.09
Electricity	0.01	75.99	1,006.35	455.03	1,640.49	79.90
Water	0.02	99.19	246.50	634.29	2,250.46	142.58
Building & Construction	2.02	8,847.51	0.00	0.00	447.79	16,800.41
Road Transport	5.64	9,999.96	504,011.25	6,240.89	350,110.11	21,874.41
Rail Transport & Pipelines	0.48	3.24	11.86	5.11	41.41	2.06
Water Transport	0.43	93.54	629.80	390.58	152,764.65	115.82
Air Transport	1.21	767.63	4,841.08	6,405.25	14,645.79	544.63
Transport Services	0.36	255.22	2,230.01	1,737.12	6,484.25	177.25
Tele communications	0.57	4,322.82	2,345.79	4,048.12	36,539.46	567.65
Post	0.00	0.00	205.84	587.72	2,255.83	49.81
Distributive Trade (Wholesale & Retail Trade)	0.05	559.69	20,365.76	5,707.27	924,497.32	1,180.45
Hotels & Restaurants	0.00	0.00	0.00	0.00	0.00	0.00
Financial Institutions	0.06	182.48	1,007.33	2,249.72	117,698.45	758.15
Insurance	0.00	17.09	63.76	182.11	1,981.43	151.94
Real Estates	5.17	4,000.01	2,410.65	0.00	57,484.08	432.33
Business Services (Not Health or Education)	0.33	1,542.68	140.27	733.26	4,045.01	0.00
Public Administration	0.00	0.00	0.00	0.00	0.00	0.00
Education	0.00	0.00	0.00	0.00	178,000.00	0.00
Health	0.00	0.00	0.00	0.00	0.00	0.00
Private Non Profit Organisations	0.00	0.00	0.00	0.00	475.50	0.00
Other Services	0.00	0.00	464.85	1,011.79	4,285.13	213.31
Broadcasting	0.00	0.00	54.45	91.02	1,813.53	19.76
Domestic Intermediate Inputs	31.66	42,399.30	768,888.98	172,108.97	5,113,809.35	305,297.06
Non Competitive Imports	0.00	2,105.52	33,052.02	567.27	79,515.54	1,200.00
Total Intermediate Inputs	31.66	44,504.82	801,941.00	172,676.24	5,193,324.89	306,497.06
Compensation of Employee	16.83	10,445.31	11,104.84	5,274.35	15,874.92	66,276.58
Consumption of Fixed Capital	7.57	209.39	441.77	541.07	8,902.59	8,626.83
Operating Surplus	20.66	39,624.01	18,466.13	6,862.21	42,642.95	0.00
Value Added at Current Basic Price	45.05	50,278.71	30,012.74	12,677.62	67,420.46	74,903.42
Indirect Taxes	0.00	0.00	7,589.54	12,542.40	53,344.61	1,484.38
Less Subsidies	0.00	0.00	0.00	0.00	0.00	159.81
Value Added at Current Producer Prices	45.05	50,278.71	37,602.28	25,220.03	120,765.06	76,227.99
Gross Input	76.71	94,783.53	839,543.28	197,896.27	5,314,089.95	382,725.05
Gross Output	76.71	94,783.53	839,543.27	197,896.26	5,314,089.96	382,725.05
	Metal Ores	Other Mining & Quarrying	Refineries (Refined Petroleum)	Cement	Other Manufacturing	Electricity

Table A3. Part 3 of 2011 input-output table of Nigeria

Activity Sector	Water	Bd. & Const.	Road Transport	Rail Transport & Pipelines	Water Transport	Air Transport
	21	22	23	24	25	26
Crop Production	0	0	0	0	0	0
Livestock	0	0	0	0	0	0
Forestry	0	47920.52	0	0	0	0
Fishing	0	0	0	0	0	0
Crude Petroleum & Natural Gas	1068.182	2668.11	0	85.57481	451936.4	66898
Coal Mining	0	0	0	0.507171	0.217359	0.289812
Metal Ores	0	1.198335	0	0.638896	0.239667	0.3595
Other Mining & Quarrying	0	166.0025	10.49003	0.237404	1.903344	37.38134
Oil Refining	2.919421	1086.097	353370.7	25.16732	201.7746	12223.64
Cement	0	21803.27	0	0	0	0
Other	30.38202	103663.7	436991.7	44.10573	353.6099	2970.272
Manufacturing	3.358233	0.849022	6.718002	0.068279	0.547411	33.16254
Electricity	11.12905	2.813625	28.34834	0.226272	1.814099	18.62214
Building & Construction	5447.196	0	98994.62	7.122487	57.10329	3459.356
Road Transport	51.15129	17904.62	48854.19	6.724244	53.91044	3265.931
Rail Transport & Pipelines	0.630343	10.55754	12.19991	1.01632	1.820483	6.38982
Water Transport	19.26204	284.4751	421.6509	2.813499	23.18331	125.2938
Air Transport	11.44525	4451.345	5484.479	1.671744	13.40291	811.9576
Transport Services	3.724784	1448.662	1784.888	0.544058	4.361892	264.2464
Telecommunications	11.92907	3801.065	17999.55	2.47744	19.86244	1203.28
Post	1.046752	333.5358	600.3266	0.21739	1.742889	105.5854
Distributive Trade (Wholesale & Retail Trade)	192.9242	150982.3	1570123	16.11027	1732.626	56363.54
Hotels & Restaurants	0	0	179.5967	0.364994	2.926277	177.2759
Financial Institutions	15.93221	2265.704	21106.09	2.905022	23.29051	1410.955
Insurance	3.192903	199.0278	205.6043	0.582183	4.667546	134.7646
Real Estates	1185.907	24613.21	191465.3	64.3175	515.6542	31238.69
Business Services (Not Health or Education)	0	0	0	0	0	0
Public Administration	0	0	0	0	0	0
Education	0	0	0	0	0	0
Health	0	0	0	0	0	0
Private Non Profit Organisations	0	0	0	0	0	0
Other Services	2.98846	2173.877	1929.784	0.265614	2.12951	129.0072
Broadcasting	0.276885	132.3395	626.6797	0.086256	0.691539	41.8939
Domestic Intermediate Inputs	8063.578	385913.3	2750196	263.7449	454953.8	180919.9

Non Competitive Imports	438.7043	34000	23400	1.12	420.5526	3200
Total Intermediate Inputs	8502.282	419913.3	2773596	264.8649	455374.4	184119.9
Compensation of Employee	1339.381	143070.1	235576	1.606365	606.843	773.7543
Consumption of Fixed Capital	1570.688	235.0067	5262.197	2.092731	269.5237	346.5387
Operating Surplus	168.5071	260575.3	261342.3	2.409548	77.68972	1704.231
Value Added at Current Basic Price	3078.575	403880.4	502180.6	6.108644	954.0564	2824.524
Indirect Taxes Less Subsidies	984.4074	15158.62	2912.465	7.493695	303.5121	965.9367
Value Added at Current Producer Prices	1216.748	0	0	3.07	169.7798	416.8021
Gross Input	2846.235	419039	505093	10.53234	1087.789	3373.659
Gross Output	11348.52	838952.3	3278689	275.3972	456462.2	187493.5
	11348.52	838952.3	3278689	275.3974	456462.2	187493.5
	Water	Building & Construction	Road Transport	Rail Transport & Pipelines	Water Transport	Air Transport

Table A4. Part 4 of 2011 input-output table of Nigeria

Activity Sector	Transport Services	Tele communications	Post	Distributive Trade (Wholesale & Retail Trade)	Hotels & Restaurants
	27	28	29	30	31
Crop Production	0	0	0	12000	11553.49827
Livestock	0	0	0	4000	3564.476833
Forestry	0	0	0	0	0
Fishing	0	0	0	0	2700.289608
Crude Petroleum & Natural Gas	16048.72063	370.6875464	111.2067873	449745.032	0
Coal Mining	0	0	0	0.072453049	0
Metal Ores	0	0	0	0	0
Other Mining & Quarrying	0	0	0	0	0
Oil Refining	2932.431689	118.2897002	35.48707708	0	0
Cement	0	0	0	133764.9956	0
Other	710.687962	2142.902672	1749.97847	644059.5346	5230.773169
Manufacturing	7.955638271	111.205444	21.42638745	1949.314991	227.223591
Electricity	3.545371223	39.93253156	110.5596623	3417.379776	296.624025
Water	829.8938374	1194.69682	358.4107329	0	0
Building & Construction	783.4915737	3812.813089	1143.84931	1602746.048	1725.842528
Road Transport	10.84835861	6.787084969	8.364623119	82.80598375	1.413355957
Rail Transport & Pipelines	71.57217077	233.9983449	158.2875137	297038.0953	722.1118395
Water Transport	194.7872904	947.9202525	284.3774142	132010.6611	429.069311
Air Transport	63.39227659	308.4945774	92.5488088	53801.53748	139.6378603
Transport Services	288.6649578	1980.875693	594.2655047	62288.14561	3722.555585
Telecommunications	25.32976724	173.8178427	52.14559824	3206.20362	326.6467369
Post					

Distributive Trade (Wholesale & Retail Trade)	68796.14138	466635.7013	718.5337737	0	0
Hotels & Restaurants	42.52818761	742.8463104	222.854942	1768.999119	235.6717405
Financial Institutions	338.4857218	540.344479	162.1041066	0	297.4098029
Insurance	67.83441556	108.2880298	32.48656184	0	59.60257364
Real Estates	7494.109544	7848.782657	6475.6812	63934.26831	3562.845961
Business Services (Not Health or Education)	0	0	0	0	0
Public Administration	0	0	0	0	0
Education	0	0	0	0	0
Health	0	0	0	0	0
Private Non Profit Organisations	0	0	0	0	0
Other Services	30.9486072	493.7024802	148.1114411	216864.6603	773.90158
Broadcasting	10.05027828	68.96698545	20.69019301	5156.985639	129.6060312
Domestic Intermediate Inputs	98751.41966	487881.0538	12501.37011	3687834.74	35699.2004
Non Competitive Imports	181.2904077	2278.685748	86.16808833	56000	2118.738867
Total Intermediate Inputs	98932.71007	490159.7396	12587.5382	3743834.74	37817.93927
Compensation of Employee	2169.311327	3248.911306	1367.197496	1132055.55	64350.27826
Consumption of Fixed Capital	6.876594368	585.3927421	205.3631853	51171	17744.20842
Operating Surplus	4216.180476	6931.657091	487.8892519	4121771	22397.888
Value Added at Current Basic Price	6392.368398	10765.96114	2060.449933	5304997.55	104492.3747
Indirect Taxes	0	15404.69107	56.83016042	11011	1397.442258
Less Subsidies	0	0	260.0158362	0	0
Value Added at Current Producer Prices	6392.368398	26170.65221	1857.264257	5316008.55	105889.8169
Gross Input	105325.0785	516330.3918	14444.80245	9059843.29	143707.7562
Gross Output	105325.0821	516330.3919	14444.8027	9059843.293	143707.7518
	Transport Services	Telecommunicati ons	Post	Distributive Trade (Wholesale & Retail Trade)	Hotels & Restaurants

Table A5. Part 5 of 2011 input-output table of Nigeria

Activity Sector	Financial Institutions	Insurance	Real Estates	Business Services (Not Health or Education)	Pub. Adm.
	32	33	34	35	36
Crop Production	0	0	0	0	0
Livestock	0	0	0	0	0
Forestry	0	0	0	0	0
Fishing	0	0	0	0	0
Crude Petroleum & Natural Gas	2737.033474	65.95985987	0	0	0

Coal Mining	0	0	0	0	0
Metal Ores	0	0	0	0	0
Other Mining & Quarrying	0	0	0	0	0
Oil Refining	1088.120641	26.22265518	0	0	0
Cement	0	0	0	0	0
Other Manufacturing	11509.31136	3184.348599	53893.50986	20918.32281	0
Electricity	367.622601	8.859349176	358.9102321	268.2139343	0
Water	31.68318104	29.35953517	124.513674	67.35558843	0
Building & Construction	0	0	0	0	0
Road Transport	13113.47104	316.0219708	0	0	0
Rail Transport & Pipelines	1.43957169	3.470607678	8.273716298	3.874476653	0
Water Transport	201.6776628	132.2271313	381.7536597	141.3529661	0
Air Transport	3260.197784	78.56761382	336.2698917	2244.179558	0
Transport Services	1061.010496	25.56932691	2277.339477	730.3538697	0
Telecommunications	13014.52407	313.6374444	27040.85046	15553.75677	0
Post	1141.998211	27.52105253	799.4459229	1364.810754	0
Distributive Trade (Wholesale & Retail Trade)	0	0	0	0	0
Hotels & Restaurants	1978.586179	132.7937886	1097.683966	1704.055596	0
Financial Institutions	4228.176105	101.8949553	17740.51385	5689.469257	0
Insurance	570.9467287	20.42031405	763.3769225	716.8553372	0
Real Estates	55154.48448	1329.169739	129368.3477	62156.03037	0
Business Services (Not Health or Education)	0	0	0	0	0
Public Administration	0	0	0	0	0
Education	0	0	0	0	0
Health	0	0	0	0	0
Private Non Profit Organisations	0	0	0	0	0
Other Services	5697.44825	137.3029931	11733.17958	3762.887878	0
Broadcasting	453.11904	10.91973068	1688.549372	541.5260134	0
Domestic Intermediate Inputs	115610.8509	5944.266667	247612.5183	115863.0452	0
Non Competitive Imports	10690.21943	444.3864946	14368.30717	1090.871452	36539.76705
Total Intermediate Inputs	126301.0703	6388.653161	261980.8255	116953.9166	23000
Compensation of Employee	299789.4823	1906.766519	940889.9	5531.609374	230206.3039
Consumption of Fixed Capital	11526.85305	2295.563103	17187.7	361.8031946	147.1937626
Operating Surplus	354337.3778	4296.659673	1104377.57	6370.303509	0
Value Added at Current Basic Price	665653.7132	8498.989295	2062455.17	12263.71608	230353.4977
Indirect Taxes	17130.08733	9353.028393	174.3524915	791.2199219	0

Less Subsidies	0	0	0	0	0
Value Added at Current Producer Prices	682783.8005	17852.01769	2062629.522	13054.936	230353.4977
Gross Input	809084.8708	24240.67085	2324610.348	130008.8526	253353.4977
Gross Output	809084.872	24240.66732	2324610.348	130008.854	253353.4938
	Financial Institutions	Insurance	Real Estates	Business Services (Not Health or Education)	Public Administration

Table A6. Part 6 of 2011 input-output table of Nigeria

Activity Sector	Education	Health	Private Non Profit Organisations	Other Services	Broadcasting
	37	38	39	40	41
Crop Production	0	0	0	0	0
Livestock	0	0	0	0	0
Forestry	0	0	0	0	0
Fishing	0	0	0	0	0
Crude Petroleum & Natural Gas	323.0327696	284.5845762	0	0	19.9933148
Coal Mining	0	0	0	0	0
Metal Ores	0	0	0	0	0
Other Mining & Quarrying	0	0	0	0	0
Oil Refining	1116.806651	468.5149729	13.05798014	18137.10643	6.380044963
Cement	0	0	0	0	0
Other Manufacturing	18230.69856	1006.122769	86.99199484	61102.65736	314.6199192
Electricity	10.08961871	5.320018324	0.057559869	69.26293593	5.997950216
Water	0	0	0	0	19.87697142
Building & Construction	9493.670325	1279.727791	24.7983965	40324.87018	64.43688181
Road Transport	51.45686479	24.72672874	3.445793107	389.1133078	205.6469744
Rail Transport & Pipelines	0	0	0	0	31.08202687
Water Transport	0	0	0	0	86.04499687
Air Transport	0	0	0	0	51.1267999
Transport Services	0	0	0	0	16.6388897
Telecommunications	0	0	0	0	106.8400373
Post	0	0	0	0	9.374997571
Distributive Trade (Wholesale & Retail Trade)	1782.292145	850.5028659	18.23412628	24708.88172	129.1816109
Hotels & Restaurants	110.9878473	58.66667247	1.635098745	2031.063757	40.06598083
Financial Institutions	753.6040582	372.1702824	1.690797453	4891.288863	29.14389052
Insurance	329.6088747	168.8992866	0.62819613	205.1178988	5.840597262
Real Estates	19719.76767	10748.14642	58.52890426	55503.69009	7861.76914
Business Services (Not Health or Education)	4.683384164	4.125955702	0.057497253	311.655803	0
Public Administration	0	0	0	0	0
Education	10477.25202	0	0	67038.62215	0
Health	5310.325632	3825.746853	0	0	0
Private Non Profit Organisations	91.6706567	22.30116561	9.220674241	489.0173862	0
Other Services	0	210.1925974	0	18523.15085	26.62821883
Broadcasting	427.2934134	206.1434413	0	0	3.719786823
Domestic Intermediate Inputs	68233.24049	19535.8924	218.3470188	293725.4987	9034.40903

Non Competitive Imports	6782.037904	120	2.826901273	6240.833649	910.4848419
Total Intermediate Inputs	75015.2784	19655.8924	221.1739201	299966.3324	9944.893872
Compensation of Employee	194043.0771	1615.42	508.5102675	221218.12	6431.018557
Consumption of Fixed Capital	419.1949283	121.6345265	0	211	69.08606741
Operating Surplus	49764.22435	1091.726929	0	100124.56	261.9555774
Value Added at Current Basic Price	244226.4964	2828.781455	508.5102675	321553.68	6762.060202
Indirect Taxes Less Subsidies	1745.43 0	886.63 0	663.28 28.72017073	51.04 0	242.3882075 138.3544133
Value Added at Current Producer Prices	245971.9264	3715.411455	1143.070097	321604.72	6866.093996
Gross Input	320987.2048	23371.30385	1364.244017	621571.0524	16810.98787
Gross Output	320987.202	23371.30035	1364.248495	621571.0562	16810.98989
	Education	Health	Private Non Profit Organisations	Other Services	Broadcasting

Table A7. Part 7 of 2011 input-output table of Nigeria

Activity Sector	inter	gcons	pcons	invest	export
Crop Production	3513812	38007.74	2467933	1336478	6683894
Livestock	572649.7	10002.04	788248.2	18904.58	4902.245
Forestry	161222.7	0	26182.02	10890.32	103103.3
Fishing	4759.227	6668.024	387644.5	12603.06	78.08905
Crude Petroleum & Natural Gas	1713183	73625.17	120818.5	263515.3	14934364
Coal Mining	1.086796	0	3.618238	9.023407	3.650722
Metal Ores	31.65799	0	22.91551	7.156495	24.0526
Other Mining & Quarrying	42399.3	0	965.2654	0	51713.3
Oil Refining	768889	546778	564390.5	16440.54	33731.37
Cement	172109	104554.6	119231.4	147615.9	5658.1
Other Manufacturing	4715809	300000.1	403503.5	82703.22	40073.8
Electricity	305297.1	14366.93	136844.3	27154.54	0
Water	8063.573	9710.644	46537.54	18353.83	0
Building & Construction	382913.3	291710.1	250644.5	58136.49	0
Road Transport	2750196	71726.07	265359.2	283260.6	8697.022
Rail Transport & Pipelines	263.7528	56.65565	5.956917	16.95942	5357.5
Water Transport	454953.8	2465.109	3061.074	162.5851	37250
Air Transport	180919.9	50010.18	232754.4	94522.92	42750
Transport Services	76875.74	66680.24	147162.1	51383.49	0
Telecommunications	224618.3	70826.48	462424.6	51502.99	3872.5
Post	12501.36	13336.05	110913	25206.11	0
Distributive Trade (Wholesale & Retail Trade)	3671835	120024.4	5592721	114420.6	13045.53
Hotels & Restaurants	12909.53	106688.4	413714.7	10395.1	0
Financial Institutions	252167.4	46676.17	380042.4	228727.5	5653.064
Insurance	6878.61	33340.12	13133.61	10462.15	0
Real Estates	900555.4	93352.34	1404045	17638.79	0
Business Services (Not Health or Education)	38763.54	36668.02	68418.18	90786.69	0
Public Administration	0	206708.8	187726	155706.9	0
Education	255515.9	107987.3	212027.9	89160.83	0
Health	9136.072	61544.56	105177.1	141400.5	0
Private Non Profit Organisations	1087.706	0	18105.81	0	0
Other Services	271473.3	144164.9	35384.37	183476.5	0

Broadcasting	13624.39	30672.91	48476.46	37974.06	0
Domestic Intermediate Inputs	21495416	2658352	15013623	3579017	21974171
Non Competitive Imports	682464				
Total Intermediate Inputs	22177880				
Compensation of Employee	12474308				
Consumption of Fixed Capital	232505.6				
Operating Surplus	23766229				
Value Added at Current Basic Price	36473043				
Indirect Taxes	177298.1	23371.3			
Less Subsidies	15859.6				
Value Added at Current Producer Prices	36634481				
Gross Input	58812361				
Gross Output	58798821				
Inter					

Table A8. Part 8 of 2011 input-output table of Nigeria

Activity Sector	import	final demand	gross output	gross inpt
Crop Production	205,995.51	10,320,316.22	13,834,127.84	13,834,127.84
Livestock	65,989.60	756,067.49	1,328,717.19	1,328,717.18
Forestry	0.00	140,175.63	301,398.35	301,398.35
Fishing	33,432.84	373,560.82	378,320.05	378,320.05
Crude Petroleum & Natural Gas	116,641.15	15,275,681.84	16,988,865.28	16,988,865.28
Coal Mining	15.45	0.84	1.93	1.93
Metal Ores	9.08	45.05	76.71	76.71
Other Mining & Quarrying	294.33	52,384.23	94,783.53	94,783.53
Oil Refining	1,090,686.12	70,654.30	839,543.27	839,543.28
Cement	351,272.72	25,787.30	197,896.26	197,896.27
Other Manufacturing	228,000.00	598,280.61	5,314,089.96	5,314,089.95
Electricity	100,937.80	77,428.00	382,725.05	382,725.05
Water	71,317.07	3,284.95	11,348.52	11,348.52
Building & Construction	144,452.08	456,039.01	838,952.35	838,952.35
Road Transport	100,549.83	528,493.03	3,278,689.26	3,278,689.26
Rail Transport & Pipelines	5,425.43	11.64	275.40	275.40
Water Transport	41,430.42	1,508.34	456,462.17	456,462.18
Air Transpsort	413,463.88	6,573.65	187,493.54	187,493.55
Transport Services	236,776.45	28,449.34	105,325.08	105,325.08
Telecommunications	296,914.52	291,712.09	516,330.39	516,330.39
Post	147,511.73	1,943.44	14,444.80	14,444.80
Distributive Trade (Wholesale & Retail Trade)	452,203.53	5,388,008.54	9,059,843.29	9,059,843.29
Hotels & Restaurants	400,000.01	130,798.22	143,707.75	143,707.76
Financial Institutions	104,181.64	556,917.45	809,084.87	809,084.87
Insurance	39,573.82	17,362.06	24,240.67	24,240.67
Real Estates	90,981.27	1,424,054.93	2,324,610.35	2,324,610.35
Business Services (Not Health or Education)	104,627.58	91,245.32	130,008.85	130,008.85
Public Administration	296,788.13	253,353.49	253,353.49	253,353.50
Education	343,704.70	65,471.33	320,987.20	320,987.20
Health	293,886.93	14,235.23	23,371.30	23,371.30
Private Non Profit Organisations	17,829.27	276.54	1,364.25	1,364.24
Other Services	12,927.99	350,097.75	621,571.06	621,571.05
Broadcasting	113,936.83	3,186.60	16,810.99	16,810.99
Domestic Intermediate Inputs	5,921,757.72	37,303,405.30	58,798,821.01	58,798,821.02
Non Competitive Imports				
Total Intermediate Inputs				
Compensation of Employee				
Consumption of Fixed Capital				
Operating Surplus				
Value Added at Current Basic Price				

Indirect Taxes
Less Subsidies
Value Added at Current Producer Prices
Gross Input
Gross Output

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Production

$$VA_j = v_j X S_j$$

$$CI_j = i_o_j X S_j$$

$$VA_{tr} = A_{tr} L D_{tr}^{\alpha_{tr}} K D_{tr}^{1-\alpha_{tr}}$$

$$L D_{tr} = \frac{\alpha_{tr} P V A_{tr} V A_{tr}}{W}$$

$$K D_{tr} = \frac{(1 - \alpha_{tr}) \cdot P V A_{tr} \cdot V A_{tr}}{R_{tr}}$$

$$D I_{i,j} = a_{ij} i_{j,j} C I_j$$

Household Income and Saving

$$Y H_{SAL} = W \cdot \sum_j L D_j + C F C$$

$$Y H_{CAP} = \lambda \cdot \sum_{tr} R_{tr} \cdot K D_{tr}$$

$$Y D H_h = Y H_h - D T H_h$$

$$S H_h = \psi_h Y D H_h$$

$$C T H_j = Y D H_h - S H_h$$

Incoming from Government

$$I_{tr} = t x_{tr} \{ P L_{tr} \cdot D D_{tr} + (1 + t m_{tr}) \cdot e \cdot P W M_{tr} \cdot I M_{tr} \}$$

$$T I M_{tr} = t m_{tr} \cdot e \cdot P W M_{tr} \cdot E X_{tr}$$

$$Y G = \sum_{tr} \{ T I t r + T I M t r + T I E t r \} + \sum_h D T H_h$$

Government Saving

$$D T H_j = T Y H_h - Y H_h$$

$$S G = Y G - G - S U B$$

Demand

$$C_{tr,h} = \frac{\gamma_{tr,h} CTH_h}{PC_{tr}}$$

$$INV_{tr} = \frac{\mu_{tr} IT}{PC_{tr}}$$

$$DIT_{tr} = \sum_j DI_{tr,j}$$

Price of Composite Capital

$$PCI_j = \frac{\sum PC_{tr} DI_{tr,j}}{CI_j}$$

$$PD_{tr} = PL_{tr} (1 + tx_{tr})$$

$$P_j = \frac{PVA_i VA_j + PCI_i CI_j}{XS_j}$$

Importation Price

$$PM_{tr} = (1 + tm_{tr}) (1 + tx_{tr}) ePWM_{tr}$$

Consumer Price

$$PC_{tr} = \frac{PM_{tr} \cdot IM_{tr} + PD_{tr} DD_{tr}}{Q_{tr}}$$

Exportation Price

$$PE_{tr} (1 + te_{tr}) = ePWM_{tr}$$

Consumer Price for Exportation

$$PC_{tr} = \frac{PE_{tr} \cdot EX_{tr} + PL_{tr} DS_{tr}}{XS_{tr}}$$

Equilibrium

$$LS = \sum_j LD_j$$

$$KS_{tr} = KD_{tr}$$

$$DS_{tr} = DD_{tr}$$

$$IT = \sum_h SH_h + SG$$

$$Q_j = \sum_h C_{h,j} + DIT_j + INV_j$$

Exportation Calibration

For the supply and ratio, the calibration is as follow:

$$XS_{tr} = A_{tr}^E \left[\beta_{tr}^E \cdot EX_{tr}^{\rho_{tr}^E} + (1 - \beta_{tr}^E) \cdot DS_{tr}^{\rho_{tr}^E} \right] \frac{1}{\rho_{tr}^E}$$

$$\Rightarrow A_{tr}^E = \frac{XS_{tr}}{\left[\beta_{tr}^E EX_{tr}^{\rho_{tr}^E} + (1 - \beta_{tr}^E) \cdot DS_{tr}^{\rho_{tr}^E} \right] \frac{1}{\rho_{tr}^E}}$$

$$\frac{EX_{tr}}{DS_{tr}} = \left[\left(\frac{PE_{tr}}{PL_{tr}} \right) \cdot \left(\frac{1 - \beta_{tr}^E}{\beta_{tr}^E} \right) \right]^{\sigma_{tr}^E}$$

$$\frac{EX_{tr}}{DS_{tr}} = \left[\left(\frac{PE_{tr}}{PL_{tr}} \right) \cdot \left(\frac{1 - \beta_{tr}^M}{\beta_{tr}^M} \right) \right]^{\sigma_{tr}^M}$$

$$\frac{EX_{tr}^{\rho_{tr}^E - 1}}{DS_{tr}^{\rho_{tr}^E - 1}} = \frac{PE_{tr}^{1 - \rho_{tr}^E}}{DS_{tr}^{1 - \rho_{tr}^E}} = \left[\left(\frac{PE_{tr}}{PL_{tr}} \right) \cdot \left(\frac{1 - \beta_{tr}^E}{\beta_{tr}^E} \right) \right]^{\sigma_{tr}^E}, \sigma_{tr}^E = \frac{1}{\rho_{tr}^E - 1}$$

$$\beta_{tr}^E \cdot PL_{tr} \cdot DS_{tr}^{1 - \rho_{tr}^E} = (1 - \beta_{tr}^E) \cdot PE_{tr} \cdot EX_{tr}^{1 - \rho_{tr}^E}$$

$$\beta_{tr}^E \cdot PL_{tr} \cdot DS_{tr}^{1 - \rho_{tr}^E} + \beta_{tr}^E \cdot PE_{tr} \cdot EX_{tr}^{1 - \rho_{tr}^E} = PE_{tr} \cdot EX_{tr}^{1 - \rho_{tr}^E}$$

$$\beta_{tr}^E \cdot \left\{ PL_{tr} \cdot DS_{tr}^{1 - \rho_{tr}^E} + PE_{tr} \cdot EX_{tr}^{1 - \rho_{tr}^E} \right\} = PE_{tr} \cdot EX_{tr}^{1 - \rho_{tr}^E}$$

$$\Rightarrow \beta_{tr}^E = \frac{PE_{tr} \cdot EX_{tr}^{1 - \rho_{tr}^E}}{\left\{ PL_{tr} \cdot DS_{tr}^{1 - \rho_{tr}^E} + PE_{tr} \cdot EX_{tr}^{1 - \rho_{tr}^E} \right\}}$$

For Importation the calibration is as follow:

We have parameters A_{tr}^M and β_{tr}^M calibrate in this section.

$$Q_{tr} = A_{tr}^M \left[\beta_{tr}^M \cdot IM_{tr}^{-\rho_{tr}^M} + (1 - \beta_{tr}^M) \cdot DD_{tr}^{-\rho_{tr}^M} \right] \frac{-1}{\rho_{tr}^M}$$

$$\Rightarrow A_{tr}^M = \frac{Q_{tr}}{\left[\sqrt{\beta_{tr}^M} \cdot IM_{tr}^{-\rho_{tr}^M} + (1 - \beta_{tr}^M) \cdot DD_{tr}^{-\rho_{tr}^M} \right] \frac{-1}{\rho_{tr}^M}}$$

Parameter β_{tr}^M can be calibrate as:

$$\begin{aligned}\frac{IM_{tr}}{DD_{tr}} &= \left[\left(\frac{PD_{tr}}{PM_{tr}} \right) \cdot \left(\frac{\beta_{tr}^M}{1 - \beta_{tr}^M} \right) \right]^{\sigma_{tr}^*} \\ \left[\frac{IM_{tr}}{DD_{tr}} \right]^{\frac{1}{\sigma_{tr}^*}} &= \left[\left(\frac{PD_{tr}}{PM_{tr}} \right) \cdot \left(\frac{\beta_{tr}^M}{1 - \beta_{tr}^M} \right) \right] \sigma_{tr}^M = \frac{1}{1 + \rho_{tr}^M} \Rightarrow \frac{1}{\sigma_{tr}^M} = 1 + \rho_{tr}^M \\ \frac{IM_{tr}^{1+\rho_{tr}^M}}{DD_{tr}^{1+\rho_{tr}^M}} &= \left(\frac{PD_{tr}}{PM_{tr}} \right) \cdot \left(\frac{\beta_{tr}^M}{1 - \beta_{tr}^M} \right) \\ \beta_{tr}^M \cdot PD_{tr} \cdot DD_{tr}^{1+\rho_{tr}^M} &= (1 - \beta_{tr}^M) \cdot PM_{tr} \cdot IM_{tr}^{1+\rho_{tr}^M} \\ \beta_{tr}^M &= \frac{PD_{tr} \cdot DD_{tr}^{1+\rho_{tr}^M}}{(1 - \beta_{tr}^M) \cdot PM_{tr} \cdot IM_{tr}^{1+\rho_{tr}^M}}\end{aligned}$$

where

$$\rho_{tr}^M = \frac{1 - \sigma_{tr}^M}{\sigma_{tr}^M}$$