Nigeria

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Nigeria is the most populous country in Africa, and the second largest country by GDP after South Africa It possesses the second largest proved oil reserves, after Libya, and it is the top producer of crude oil in Africa (BP, 2011). Hence it is important to have Nigeria represented by an adequate IOT in the GTAP database. GTAP database version 8 includes a Nigerian IOT for the year 1999, which relies on the official 1990 IOT with 30 sectors and an un-official 1999 IOT including 18 sectors (Horridge and Osakwe, 2006; Horridge, 2008). Therefore, a considerable effort is made to use the most recent reliable sources of data to put together a more detailed (38 sectors) and up to date IOT.

1. Sources of data

The Nigerian IOT described here relies mainly on the latest Social Accounting Matrix (SAM) developed for the Nigerian Economy, which represents the monetary flows in 2006 (Nwafor et al., 2010). In addition, data from different domestic sources in Nigeria are used to reconcile several aspects of the SAM and during the conversion process to an IOT. Major domestic sources include, but are not limited to the Nigerian National Bureau of Statistics (NBS) and the Central Bank of Nigeria (CBN).

The Nigerian SAM of Nwafor et al. (2010) comprises 61 activities, 62 commodities, 12 household groups, 3 production factors (labor, land and capital), and 4 tax accounts. In addition, the SAM also includes accounts for government, enterprises, rest of the world, and trade-margins (one account each). The SAM's sectors include 27 cropping and 6 livestock sectors besides fishery and forestry, 2 mining sectors, 12 manufacturing sectors, and 13 services sectors. The detailed nature of the agricultural sector in the SAM leads to a detailed representation of its sectors in the final IOT. However, for manufacturing, some GTAP sectors had to be aggregated to accord the SAM's sectors (Table 1).

2. Moving from SAM to IOT

SAMs are usually structured in an industry by commodity setup, which implies that the production activities (industries) are separated from their output (commodities). The two accounts are then linked by the make-matrix in which commodities pay activities and the use-matrix where activities pay commodities for intermediate use. Because the required IOT format of the GTAP database is commodity by commodity, conversion was needed in this respect.

Additionally, the procedure of moving from a SAM to an IOT in the from GTAP required form involves generating matrices that distinguish between the use of domestic and imported commodities as well as between the use at basic (tax exclusive) and purchaser (tax inclusive) prices. In the SAM of Nwafor et al. (2010), there is no such distinction. Figure 1 explains the structure of the data in the SAM and the required adjustments to generate the IOT in the format of the GTAP database.

The process depicted in Figure 1 is automatized and coded in GAMS by embedding instructions provided in the GTAP contributor guide (Huff et al., 2000). The GAMS code was developed by McDonald and Lakatos (2009) in collaboration with the GTAP database team. The code is also used for the removal of trade and transport margins, by increasing the consumption of the trade commodity and decreasing consumption of other commodities by the same value.

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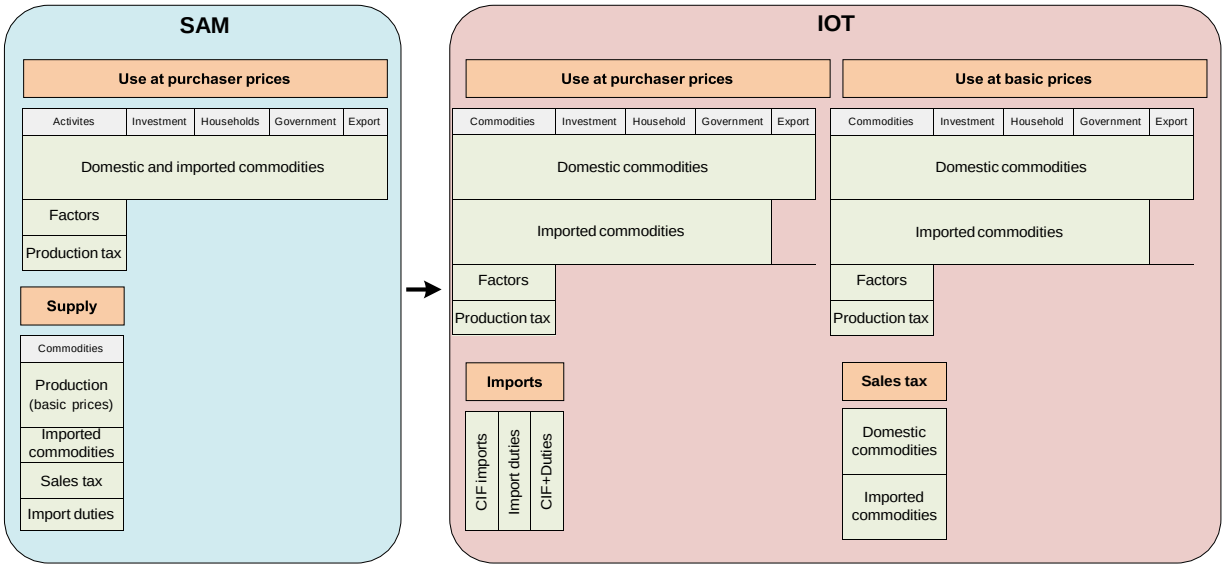
Figure 1: Moving from the SAM to the IOT database



Source: Own compilation based on Siddig et al. (2012)

3. Special treatments and adjustments

3.1 Mapping and aggregations

The 62 commodities of the SAM are mapped to 38 sectors in the IOT, and the mapping between the two is shown in Table 1. Also the final demand by households is aggregated as the SAM comprises 12 different household groups and the IOT only one. The mapping between the different final demand categories in the SAM and the IOT is shown in Table 2. The three factors of production (labor, capital, land) specified in the SAM are directly included in the IOT without further aggregation or disaggregation. The same holds true for the enterprises, savings-investments, government and rest of the world accounts.

The submitted IOT of Nigeria for 2006 includes 38 sectors, 8 of which are cropping and 4 livestock activities besides fishery and forestry. The 14 sectors that comprise agriculture and related sectors are results of aggregations from the 32 agricultural sectors of the original SAM (Table 2). On the other side two manufacturing sectors of the standard GTAP aggregation are merged with agricultural activities. c_b (Sugar cane and sugar beet) and sgr (Sugar) were aggregated to one sector, because sugar is represented by only one activity and one commodity in the Nigerian SAM, while it has proven difficult to rely on domestic sources of data to separate them. The same approach is also followed for rmk (Raw milk) and mil (Dairy products).

The Nigerian SAM of Nwafor et al. (2010) is an agricultural-focused SAM, as the agricultural sector is represented by more than half of the total number of activities. On the other hand, the manufacturing sector is relatively aggregated. Therefore ten standard GTAP manufacturing sectors (from 31 to 42) are mapped to two SAM sectors, namely ‘Other manufactured products’ and ‘Fertilizer’. As definitions overlap these two sectors are further aggregated and hence are represented by only one sector in the contributed IOT.

3.2 The Zero-Sectors

Neither the 2006 Nigerian SAM nor the other domestic sources of data provide information on wol (Wool, silk-worm cocoons), gdt (Gas manufacture and distribution) and dwe (Dwellings). Therefore, they are included as zero-sectors in the IOT as suggested by Horridge et al. (2008). Also the GTAP sector, coa (Coal) is included as a zero-sector based on CBN (2012a) and CBN (2012b). The two reports of the CBN show the domestic transactions of coal to be zero during 2010 and 2011 as well as during the first two quarters of

2012.[3]

All remaining 10 manufacturing and 8 service activities are one to one mappings of the standard GTAP sectors or simple aggregates. Because the 2006 Nigerian SAM includes no account for the changes in stock, the resulting IOT provide no information on that as well.

3.3 Mandatory splits

According to Horridge et al. (2008), IOTs contributed to GTAP need to satisfy the condition of the so called 'mandatory splits'. This is the separation of agriculture and food processing, as well as energy, from all other sectors. Except for one case, which is the representation of water distribution and electricity supply by only one utility sector, the SAM of Nwafor et al. (2010) is satisfying the mandatory splits condition.

The approach applied to separate water from electricity, which makes the entire data set compatible to GTAP database by particularly satisfying the mandatory splits condition is described hereafter. Additional data from the Nigerian National Bureau of Statistics (NBS) and the Central Bank of Nigeria (CBN) are used to disaggregate the utility sector of the SAM, which comprises water and electricity in one sector to two separate accounts.

The SAM provides data on the income to the utility commodity from activities (intermediate use). To separate water and electricity, the share of each in the GTAP database version 8 (Narayanan et al., 2012) is used. This assumes that, industries' total consumption of water and electricity changes, but the share of each relative to the other is fixed between 1999 (being the base year of the IOT by Narayanan et al. ,2012) and 2006 (the current IOT). Narayanan et al. (2012) also suggests that both commodities are subject to similar tax rate, which is also applied for this IOT. For household's consumption of the two commodities, the share of water in each household group's consumption from NBS (2012) for 2009-2010 is used to calculate water consumption value per household group. This value is then subtracted from the value of the composed utility-consumption to single out electricity consumption value per household group. This assumes that the share of water in total household's expenditure remained the same between 2006 and 2009/10.

3.4 The treatment of taxes

The SAM of Nwafor et al. (2010) includes 4 tax accounts including sales tax and import tax, both are levied on commodities, production tax levied on activities, which is a subsidy in several sectors and income tax on households and enterprises. These 4 accounts are also included in the IOT. More detailed information on the tax accounts and the respective data sources can be found in Nwafor et al. (2010).

4. Tables of mapping

Table 1: Mapping between the sectors of the Nigerian SAM, GTAP and IOT sectors

SAM	GTAP	IOT
No. code commodity description	**No. code commodity description**	**No. code**
1 crice Rice	1 pdr Paddy rice	1 pdr
2 cwhet Wheat	2 wht Wheat	2 wht
3 cmaze Maize	3 gro Cereal grains nec	3 gro
4 csorg Sorghum		
5 cmilt Millet		
6 ccass Cassava	4 v_f Vegetables, fruit, nuts	4 v_f
7 cyams Yams		

[3] No similar reports were found for the same year of the IOT and SAM, which is 2006.

SAM No. code commodity description	GTAP No. code commodity description	IOT No. code
8 ccyam Cocoyams		
9 cpota Irish potato		
10 cspot Sweet potato		
11 cplan Banana and plantain		
16 cveg Vegetables		
17 cfrt Fruits		
18 ccoco Cocoa		
24 cnuts Nuts		
25 ccash Cashew		
13 cgnut Groundnuts	5 osd Oil seeds	5 osd
14 csoys Soyabeans		
15 cosed Beniseed		
21 cpalm Oil palm		
22 csuga Sugar and sugar cane	6 c_b Sugar cane, sugar beet 24 sgr Sugar	6 c_b_sgr
20 ccott Cotton	7 pfb Plant-based fibers	7 pfb
12 cbean Beans	8 ocr Crops nec	8 ocr
19 ccoff Coffee		
23 ctoba Unprocessed tobacco		
26 crube Rubber		
27 cocrp Other crops not specified		
28 ccatl Cattle	9 ctl Cattle, sheep, goats, horses	9 ctl
29 cgshp Live goats and sheep		
30 cpoul Live poultry	10 oap Animal products nec	10 oap
37 ceggs Eggs		
31 coliv Other live animals		
38 cmilk Milk and dairy products	11 rmk Raw milk 22 mil Dairy products	11 rmk_mil
Zero sector	12 wol Wool, silk-worm cocoons	12 wol
33 cfore Forestry	13 frs Forestry	13 frs
32 cfish Fish and fish meat	14 fsh Fishing	14 fsh
Zero sector	15 coa Coal	15 coa
47 ccoil Crude petroleum and natural gas	16 oil Oil 17 gas Gas	16 oil_gas
49 comin Other mining	18 omn Minerals nec	17 omin
34 cbeef Beef	19 cmt Meat: cattle, sheep, goats, horse	18 cmt
35 cgsmt Goat and sheep meat		
39 comet Other livestock meat	20 omt Meat products nec	19 omt
36 cpmet Poultry meat		
41 cofod Processed food products (excluding beverages)	21 vol Vegetable oils and fats 23 pcr Processed rice 25 ofd Food products nec	Vol_pcr 20 _ofd
40 cbevg Beverages and tobacco products	26 b_t Beverages and tobacco	21 b_t
42 ctext Textiles and leather products	27 tex Textiles 28 wap Wearing apparel	22 tex_wa p_lea

SAM	GTAP	IOT
No. code commodity description	**No. code commodity description**	**No. code**
	29 lea Leather products	
43 cwood Wood, wood products, furniture	30 lum Wood products	23 lum
46 cfert Fertilizer	33 crp Chemical,rubber,plastic prods	24 omfc_fe rt
45 comfc Other manufactured products	31 ppp Paper products, publishing	
	34 nmm Mineral products nec	
	35 i_s Ferrous metals	
	36 nfm Metals nec	
	37 fmp Metal products	
	38 mvh Motor vehicles and parts	
	40 ele Electronic equipment	
	41 ome Machinery and equipment nec	
	42 omf Manufactures nec	
48 croil Refined Oil	32 p_c Petroleum, coal products	25 p_c
44 cemfc Transportation and other	39 otn Transport equipment nec	26 otn
51 cutil Electricity and water	43 ely Electricity	27 ely
	45 wtr Water	28 wtr
Zero sector	44 gdt Gas manufacture, distribution	29 gdt
50 ccons Building and construction	46 cns Construction	30 cns
54 ctrad Wholesale and retail trade	47 trd Trade	31 trd
55 chotl Hotel and restaurants		
52 crtra Road transport	48 otp Transport nec	32 otp
53 cotra Other transportation	49 wtp Sea transport	33 atp_wtp
	50 atp Air transport	
56 ccomm Telecommunications, Post, broadcasting	51 cmn Communication	34 cmn
57 cbser Financial institutions, Insurance, Business service	52 ofi Financial services nec	35 ofi_isr_ obs
	53 isr Insurance	
58 crest Real estate	54 obs Business services nec	
62 coser Private nonprofit organizations, Other services	55 ros Recreation and other services	36 ros
59 ceducEducation	56 osg PubAdmin/Defence/Health/ Education	37 osg
60 cheal Health		
61 cpser Public administration		
Zero sector	57 dwe Dwellings	38 dwe

Table 2: Mapping of final demand between SAM and IOT

SAM		IOT
Description	**Code**	**Code**
Households in rural South South zone	h-rur-ss	hhous
Households in rural South East zone	h-rur-se	
Households in rural South West zone	h-rur-sw	
Households in rural North Central zone	h-rur-nc	
Households in rural North East zone	h-rur-ne	
Households in rural North West zone	h-rur-nw	
Households in urban South South zone	h-urb-ss	
Households in urban South East zone	h-urb-se	
Households in urban South West zone	h-urb-sw	
Households in urban North Central zone	h-urb-nc	
Households in urban North East zone	h-urb-ne	
Households in urban North West zone	h-urb-nw	
Government	GOVT	govt
Savings - Investments	KAP	i_s
Rest of the World	ROW	ROW

References

BP (2011): British Petroleum Statistical Review of World Energy. June 2011. bp.com/ statisticalreview. Accessed on January 2, 2012.

CBN (2012a): First Quarter 2012 GDP Report, Central Bank of Nigeria (CBN). Accessed on November 25, 2012. http://www.cenbank.org/OUT/2012/PUBLICATIONS/REPORTS/GOV/GDP%20REPORT.PDF

CBN (2012b): Quarterly Statistical Bulletin 2012, Quarter Two. Statistics Department, Central Bank of Nigeria. Volume 1, Number 2, June 2012.

Horridge, Mark and Osakwe, Patrick (2006): GTAP 6 Data Base Interim Release 1, Candidate 1. Center for Global Trade Analysis (GTAP), Purdue University, USA.

Horridge, M., McDougall, R., Narayanan, B. and T. Walmsley (2008): Exercises in Contributing I-O Tables to the GTAP Data Base. September 2008.

Horridge, Mark (2008): GTAP 7 Data Base Documentation - Chapter 7 I-O Table: Nigeria. Center for Global Trade Analysis (GTAP), Purdue University, USA. https://www.gtap.agecon.purdue.edu/resources/download/4075.pdf

Huff, K., McDougall, R. and T. Walmsley (2000): Contributing Input-Output Tables to the GTAP Data Base. GTAP Technical Paper No. 1 Release 4.2. January 2000.

McDonald, S. and C. Lakatos (2009): Symmetric IO Tables from Supply and Use for GTAP V7 (GAMS-code). Department of Economics & Strategy, Oxford Brookes University Oxford, UK.

Narayanan, G., Badri, Angel Aguiar and Robert McDougall, Eds. 2012. Global Trade, Assistance, and Production: The GTAP 8 Data Base, Center for Global Trade Analysis, Purdue University

NBS (2012): Consumption Pattern in Nigeria 2009/10. National Bureau of Statistics. Nigeria.
Preliminary Report, March 2012.

Nwafor, Manson; Diao, Xinshen; and Alpuerto, Vida (2010). A 2006 Social Accounting Matrix for Nigeria. Methodology and Results. Nigeria Strategy Support Program (NSSP), Report No. NSSP007. April 2010. International Food Policy Research Institute.

Siddig, Khalid, Dorothee Flaig, Jonas Luckmann and Harald Grethe (2012). GTAP 8 Data Base Documentation - Chapter 7.R: Israel. In Narayanan, G., Badri, Angel Aguiar and Robert McDougall, Eds. 2012. Global Trade, Assistance, and Production: The GTAP 8 Data Base, Center for Global Trade Analysis, Purdue University.