

Modeling household and labor heterogeneity in selected Least Developed Countries (LDCs)

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The analysis of the impact of global trends and the COVID-19 crisis on LDC economies individually and as a group requires a global database and country-specific details on income generation, distribution and consumption and factor employment. This paper aims at providing scenario analysis for LDCs by expanding the GTAP global databases with LDC country-specific data on household, government, firms and labor demand as well as adapting the MyGTAP modelling framework for a richer account of the impact of global and country-specific shocks on the income generation and distribution of LDCs. The dataset includes household and labor breakdowns from GTAP, IFPRI and ILO data. The labour market adjustment is enhanced by introducing a wage curve that allows the wages and employment determination to affect the generation and distribution of incomes across households and firms.

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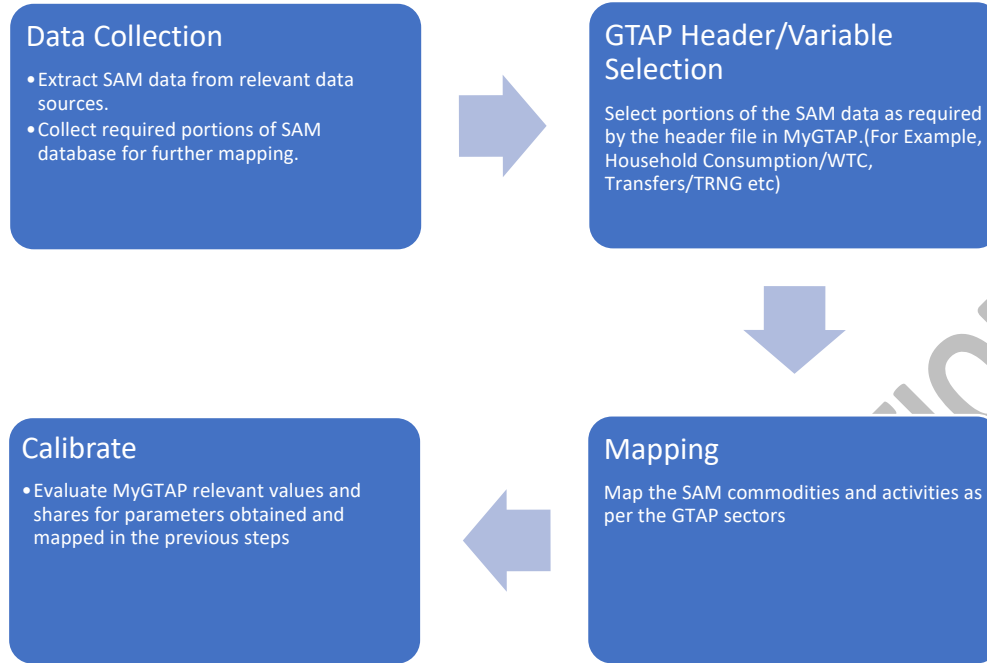
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INTRODUCTION

The standard, static GTAP model forms the basis for the MyGTAP model (Walmsley & Minor, 2013), where the latter facilitates splitting regional households and factors in the GTAP model into multiple households and factors. The regional household is replaced with separate government and multiple private households linked to their income sources and then these incomes are linked to expenditures. Households obtain income by supplying factor services, foreign income and transfers, remittances while also saving a share of their income. On the other hand, the government receives income from tax collection and aid payments while saving its income share that forms the income. This increases the accuracy of country-level analysis, as the model introduces a direct link between the sources of income and change in household and government income. Because it allows for increased factor types, MyGTAP model buttresses the link between economic activity and household income. As it directly maps taxes and subsidies to the government expenditure, it is easy to arrive at the government deficit of that country. And by capturing the linkages between taxes and government expenditure, and between factor incomes and household expenditure while expanding the private household into multiple households, the model becomes capable of measuring the distributional impact of trade policies, liberalization agreements and negotiations on social welfare, notably on inequality and poverty. Because it permits inclusion of multiple households, the study shall incorporate different types based on income and financial status, or on regional divides, which shall enable the analysis of distributional impact to evaluate the progress. By keeping almost all the disaggregated GTAP sectors, the model shall capture the essential attributes of the significant industries that make up the economy. The fact that factor inputs like labour can be further split based on gender, skill sets or occupations, enrich the abilities of the model to perform analysis at the micro-level. This shall provide a better picture of sector-income linkage, which is essential to perform trade-policy analysis.

DATABASE METHODOLOGY

Below is outline of the major steps involved in converting SAM data to MyGTAP readable format:



In the next sections, we will dive deeper into each step and present a complete step by step process of converting the SAM into MyGTAP format.

COUNTRY AGGREGATION

The first step involves aggregating the 141 regions in GTAP database into 23 countries/regions while the 65 sectors in the GTAP database are retained as is, except for dwellings which is aggregated to the real estate services (rsa) sector. Along with the 8 factor endowments in the aggregated database, there are aggregated regions and countries shown in table 1, which are further broken down into all LDCs separately identified. Countries that are not available in the GTAP database are included by using the SplitReg programs from GEMPACK. The aggregated database is then scaled to the latest, using 2019 GDP as present in world bank database, while adding new countries using SplitReg. The household types and disaggregated countries are shown in table 2.

Table 1: GTAP country/region mappings

GTAP Code	Country Mapped	Region Description
<i>Ausnzl</i>	aus nzl	Australia and New Zealand

<i>RoW</i>	xoc mng xea brn khm lao phl xse npl pak lka xsa mex xna bol chl col ecu pry per ury ven xsm cri gtm hnd nic pan slv xca dom jam pri tto xcb che nor xef alb blr ukr xee xer kaz kgz tjk xsu arm aze geo bhr irn isr jor kwt omn qat are xws egy mar tun xnf ben bfa cmr civ gha gin nga sen tgo xwf xcf xac eth ken mdg mwi mus moz rwa tza uga zmb zwe xec bwa nam xsc xtw	Rest of the World
<i>Chnhkg</i>	chn hkg	China and Hong Kong
<i>Jpn</i>	jpn	Japan
<i>Kor</i>	kor	Korea
<i>Twn</i>	twm	Taiwan
<i>Idn</i>	idn	Indonesia
<i>Mys</i>	mys	Malayasia
<i>Sgp</i>	sgp	Singapore
<i>Tha</i>	tha	Thailand
<i>Vnm</i>	vnm	Vietnam
<i>Bgd</i>	bgd	Bangladesh
<i>Ind</i>	ind	India
<i>Can</i>	can	Canada
<i>Usa</i>	usa	United States of America
<i>Arg</i>	arg	Argentina
<i>Bra</i>	bra	Brazil
<i>EU_27</i>	aut bel bgr hrv cyp cze dnk est fin fra deu grc hun irl ita lva ltu lux mlt nld pol prt rou svk svn esp swe	European Union
<i>Gbr</i>	gbr	United Kingdom
<i>Rus</i>	rus	Russia
<i>Sau</i>	sau	Saudi Arabia
<i>Tur</i>	tur	Turkey
<i>Zaf</i>	zaf	South Africa

Once we have the initial step completed, the next step is to scale this database to the most recent year. For this purpose, the GTAP aggregated database is then scaled using 2019 GDP as present in world bank database, using the GTAPAdjust tool. The database is then used to create the MYGTAP model for the LDCs, that splits and maps factor endowments and households based on the social accounting matrix for the particular country. After the mapping, based on the data present in Social Accounting Matrix(SAM) matrix and the world bank policy research working paper the weights/shares in the MyGtap model are adjusted. The income and savings specific to government and various household types are updated in the MyGtap model directly from the latest available

SAM matrix. Next, the weight shares for each factor/endowment commodity across each household type shall be calculated. A similar approach is used to calculate the factor weights by commodity, using the labor factor ratio and then splitting the commodity values based on the factor ratios.

DATA COLLECTION AND EXTRACTION

The first step in converting a SAM into MyGTAP readable format is to collect the most recently available SAM data. There are two main sources for us to collect this data, International Food Policy Research Institute and The African Growth and Development Policy.

International Food Policy Research Institute (IFPRI) through various projects collaborates between various international organizations and national statistical agencies and research institutions to improve the quality of social accounting matrices (SAMs), which is used for country-level computable general equilibrium (CGE) modelling. IFPRI establishes common data standards, procedures, and classification systems for constructing and updating national SAMs.

The African Growth and Development Policy (AGRODEP) Modelling Consortium is an initiative aimed at positioning African experts to take a leadership role in the study of strategic development questions and the broader agricultural growth and policy debate facing African countries. AGRODEP maintains repositories of economic models and data sets, related documentation, and research output available to all network members. For those countries, whose SAM data is not present in the IFPRI database, we utilize the AGRODEP database.

A national SAM captures the detailed economic structure of a country. A SAM is a square matrix in which each account is represented by a row and a column. Each cell reflects a payment from the column account to the row account, i.e., incomes appear along rows and expenditures along columns. Double-entry accounting requires that, for each account, total revenue (row total) equals total expenditure (column total). Table 1 shows an aggregate SAM, with verbal explanations in place of numbers.

Table 1: SAM format of shares required for MyGTAP

	Commodities	Activities	Factors	Households	Government	Capital	Margins	Rest of World	Totals
Commodities	0	Combined Intermediate Use Matrix	0	WTC: Private Consumption	Government Consumption	Investment Consumption	Exports of Margins (fob)	Exports of Commodities (fob)	Total Demand for Commodities
Activities	Domestic Supply Matrix	0	0	0	0	0	0	0	Total Domestic Supply by Activity
Factors	0	WTF: Expenditure on Primary Inputs	0	0	0	0	0	0	Total Factor Income
Households	0	0	OWN: Distribution of Factor Incomes	TRNH: Transfers	TRNG: Transfers	0	0	RMI, FYI: Remittances	Total Household Income
Government	Taxes on Commodities	Taxes on Production	0	Direct/ Income Taxes	0	0	0	Foreign aid	Total Government Income
		Taxes on Factor Use	Direct Taxes						
Capital	0	0	Depreciation Allowances	SHLD: Household Savings	Government Savings	0	Balance on Margins Trade	Foreign Savings	Total Savings
Margins	Imports of Trade and Transport Margins	0	0	0	0	0	0	0	Total Income from Margin Imports
Rest of World	Imports of Commodities (fob)	0	0	RMO, FYO: Remittances	Foreign aid	0	0	0	Total Income from Imports

SOURCE: MyGTAP Multiple household documentation. Once the data is collected, the next step is to extract relevant portions of the SAM data pertaining to each country's production, consumption, wages, transfers, savings share, and income.

After extracting the required data, we carefully scan through each country's detailed SAM documentation to capture their intricate details. This has strengthened our understanding of the country's general macro-economic picture as well as identifying their primary commodities and their mapping with respect to global standards. The following are examples of the documents we referred to, Malawi's and Senegal's SAM documentations.

In this step we also identify all relevant household and factor/labour categories for all the LDC countries relevant to the study. Based on this extensive SAM literature review, we have created 84 household and 48 factor types in our MyGTAP model. Refer Appendix A to see the exhaustive list of household and factor types as present in our MyGTAP model.

GTAP HEADER/VARIABLE SELECTION

In the MyGTAP userwgt header file, we look at the following seven important economic variables:

1. Shares for factor use by activity – Header array name as per MyGTAP is WTF

2. Factor ownership shares by household– Header array name as per MyGTAP is OWNWGT
3. Weights of each commodity in the private household consumption basket - Header array name as per MyGTAP is WTC
4. Transfers of income from government to households, for example pension payments – Header array name as per MyGTAP is TRNG
5. Household Savings Rate – Header array name is SHLD
6. Government Savings Rate – Header array name is SGOV
7. Household Income – Header array name is IHL

Once we map the data to relevant MyGTAP headers the next step is to convert this data into MyGTAP readable format which is essentially mapping raw SAM data to MyGTAP sectors, factors, and households. Mapping the data varies based on the header under consideration. For headers such as TRNG, SHLD, SGOV, and IHL the mapping to MyGTAP is simple. We use the table 1 SAM to MyGTAP mapping format and directly copy the values to these headers. The below section will explain in detail about our process with respect to cleaning the data for other 3 headers WTC, OWNWGT, and WTC MyGTAP header .

MAPPING THE DATA to MyGTAP FORMAT

HEADER WTC (Weights of each commodity in the private household consumption basket)

With the WTC equivalent obtained from SAM we know that the next step is be able to use this data in obtaining household consumption shares for MyGTAP. The commodities present in the original SAM household consumption data do not exactly align with the 64 GTAP sectors. In certain cases, the sectors in SAM are sub-sectors in GTAP and in other cases the sectors in SAM are aggregation of multiple GTAP sectors. We meticulously study all related literature to rightly understand the commodities definition as per SAM as well as global standards¹.

Figure 1: Sample SAM to GTAP Mapping

¹ The two main global standards used in classifying GTAP sectors as well as present in SAM commodities documentation are [CPC v.2.1](#) and [ISIC Rev. 4](#)

OSEC	MPIO	SEC	SMAP	GSEC
Rice and Wheat	→	PdrWht	→	Pdr
Yellow Maize	→	Gro	→	Wht
White Maize	→		→	Gro
Vegetables and Fruit	→	V_f	→	V_f
Soy Beans	→	Osd	→	Osd
Ground Nut	→		→	C_b
Coffee	→	ocr	→	Pfb
Other crops	→		→	Ocr
Cattle	→	Ctl	→	Ctl
Other Animal	→	Oap	→	Oap
			→	Rmk
			→	Wol

OSEC: OSEC refers to the original SAM commodities

MPIO: MPIO refers to the mapping between OSEC and SEC sector

SEC: SEC refers to the mapped sector

SMAP: SMAP refers to the mapping between SEC and GSEC sector

GSEC: GSEC refers to the GTAP sectors

We classify the original SAM commodities (OSEC) into two to obtain SEC (as in figure 2):

1. In the first case, we map a single SAM commodity to multiple GTAP sectors. For example, with reference to Malawi's SAM, wheat and barley is present as a single SAM commodity whereas GTAP lists them as separate sectors. Thus, cwhea (Wheat and barley) SAM commodity maps to multiple GTAP sectors wht and gro. This would be referred to as whtgro in the mapped sector (SEC). Additionally, a different example could be cmaiz (Maize), csorg (Sorghum and millet) map to gro in GTAP while cocer (Other Cereals) maps to both gro and wht GTAP sectors since wheat is not present elsewhere. In such cases all the three SAM commodities cmaiz, csorg, and cocer map to growht (gro and wht) mapped sector (SEC) to maintain consistent mapping framework.
2. Next, we map multiple SAM commodities to single GTAP sector. For example, Tobacco Cultivation, Tea Cultivation, Spice Cultivation, Flower Cultivation, and Other Crop Cultivation are separate commodities in the SAM while in GTAP they all refer to the same sector OCR (Other Crops)

Once we map the original sectors (OSEC) to mapped sectors (SEC), the next step is to aggregate SAM data based on SEC. Thus, removing duplicate mapped sectors (SEC), we obtain sum of household consumption value by mapped sectors (SEC). Below is a sample example of the same from Uganda's mapping tables.

Table 2: Portion of Uganda's household consumption table from SAM mapped to SEC/mapped sectors.

SAM Code/OSEC	Mapped Code/SEC	hhd- f1	hhd- f2	hhd- f3	hhd- f4	hhd- f5	hhd- n1	hhd- n2	hhd- n3	hhd- n4	hhd- n5	hhd- u1	hhd- u2	hhd- u3	hhd- u4	hhd- u5
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Cmaiz	growht	1.3	1.2	4.9	5.0	3.0	3.2	3.2	3.4	3.5	4.4	1.6	2.5	5.5	6.2	22.1
Csorg	growht	11.8	15.1	12.6	11.1	5.4	26.2	7.3	7.7	7.8	8.1	3.3	3.4	7.5	13.9	22.9
Crice	Pdr	0.9	5.1	5.1	8.7	6.9	0.7	4.0	6.0	8.5	13.2	0.4	2.1	6.7	20.0	51.2
Cocer	growht															
Cpuls	v_f	36.6	35.5	36.3	35.2	23.0	25.1	30.4	31.1	37.4	39.2	9.3	11.9	18.0	53.2	131.0
Cgnut	Osd	3.2	5.3	12.2	13.1	6.6	3.5	5.6	8.1	12.0	16.0	0.8	3.0	7.2	17.8	45.7
Coils	Osd															
Ccass	v_f	24.7	20.7	19.7	25.1	10.0	16.9	16.9	18.2	21.7	16.6	3.7	5.9	8.6	17.8	30.0
Croot	v_f	7.0	6.9	6.5	6.6	4.5	4.4	5.7	6.3	9.6	10.6	1.1	2.7	7.3	18.9	52.1
Cvege	v_f	24.2	34.2	37.8	41.6	28.2	13.4	17.6	26.7	34.1	40.7	6.8	10.7	21.8	53.0	136.0

Table 3: Aggregated sample data of the above table

SEC	hhd-f1	hhd-f2	hhd-f3	hhd-f4	hhd-f5	hhd-n1	hhd-n2	hhd-n3	hhd-n4	hhd-n5	hhd-u1	hhd-u2	hhd-u3	hhd-u4	hhd-u5
Growht	13.2	16.4	17.5	16.1	8.4	29.4	10.5	11.1	11.3	12.5	4.9	5.9	13.0	20.1	45.0
Osd	3.2	5.3	12.2	13.1	6.6	3.5	5.6	8.1	12.0	16.0	0.8	3.0	7.2	17.8	45.7
Pdr	0.9	5.1	5.1	8.7	6.9	0.7	4.0	6.0	8.5	13.2	0.4	2.1	6.7	20.0	51.2
v_f	92.5	97.3	100.3	108.5	65.8	59.8	70.5	82.3	102.9	107.1	21.0	31.1	55.6	142.8	349.1

DISAGGREGATION AND GTAP SECTOR MAPPING

After we complete the SEC aggregation the next step is to map these SECs to unique GTAP sectors (GSEC); to obtain the final household consumption values as required by the myGTAP program. The below step details this process:

1. Map the mapped sector (SEC) to unique GTAP sector (GSEC) as present in figure 2.
2. In scenarios where we must disaggregate multiple sectors to unique GTAP sectors:
To separate mapped sectors (SEC) to single unique GTAP sector (GSEC), such as growht to gro and wht, we use the respective country's private consumption value shares from the GTAP's database. And then redistribute the total household consumption value to each of the sectors using the shares. Below table shows a sample data table part of Uganda's SAM consumption value while mapping SEC to GSEC. This is a continuation of the above example:

Table 4: Disaggregation example following table 3.

Sector	hhd-f1	hhd-f2	hhd-f3	hhd-f4	hhd-f5	hhd-n1	hhd-n2	hhd-n3	hhd-n4	hhd-n5	hhd-u1	hhd-u2	hhd-u3	hhd-u4	hhd-u5
Weights															
wht	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
gro	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total Consumption Value from SAM															
gro/wht	13.2	16.4	17.5	16.1	8.4	29.4	10.5	11.1	11.3	12.5	4.9	5.9	13.0	20.1	45.0
SEC to GSEC Value															
wht	6.5	8.1	8.7	8.0	4.2	14.6	5.2	5.5	5.6	6.2	2.4	2.9	6.5	10.0	22.3
gro	6.6	8.2	8.8	8.1	4.2	14.8	5.3	5.6	5.7	6.3	2.5	3.0	6.6	10.1	22.7

And finally, we calculate the total household consumption values by aggregating the GTAP sector (GSEC) values for each household. At the beginning, SAM data was in the format SAM Commodities * SAM Households, and now it is transformed to GTAP Commodities * SAM Households. In the final step we also map the household names according to MyGTAP header set HOU. Since this MyGTAP program is a one stop CGE framework for all LDC countries, the HOU header is a comprehensive collection of all possible households. Refer Appendix A to identify exhaustive list of the same used in our MyGTAP model. Thus, once this mapping is completed, we now have the data ready to be used as in MyGTAP format, GTAP Commodities * GTAP Households.

Below is an example of how the final table looks:

Table 5: Final WTC My GTAP input table using the SAM data – Sample Example from Uganda's SAM data

GTAP Sector	RuralFarmQ1	RuralFarmQ2	RuralFarmQ3	RuralFarmQ4	RuralFarmQ5
<i>pdr</i>	0.93	5.13	5.13	8.68	6.90
<i>wht</i>	6.53	8.12	8.67	7.98	4.15
<i>gro</i>	6.62	8.24	8.80	8.10	4.21
<i>v_f</i>	104.19	132.51	147.70	181.40	111.52
<i>osd</i>	3.18	5.27	12.25	13.07	6.62
<i>c_b</i>	0.01	0.01	0.01	0.01	0.01
<i>pfb</i>	0.01	0.01	0.01	0.01	0.01
<i>ocr</i>	0.01	0.01	0.01	0.01	0.01
<i>ctl</i>	10.10	21.55	38.51	48.26	32.67
<i>oap</i>	1.33	3.30	5.49	8.36	9.28
<i>rmk</i>	4.08	10.15	16.91	25.72	28.55
<i>wol</i>	0.00	0.00	0.00	0.00	0.00
<i>frs</i>	22.74	39.84	56.64	55.84	38.34
<i>fsh</i>	15.20	25.68	43.17	34.48	31.13
<i>coa</i>	0.01	0.01	0.01	0.01	0.01
<i>oil</i>	0.01	0.01	0.01	0.01	0.01
<i>gas</i>	0.01	0.01	0.01	0.01	0.01
<i>oxt</i>	0.01	0.01	0.01	0.01	0.01
<i>cmt</i>	34.02	48.56	58.46	62.93	35.73
<i>omt</i>	11.29	16.12	19.40	20.89	11.86
<i>vol</i>	32.60	47.05	47.02	59.42	27.76
<i>mil</i>	15.47	22.08	26.59	28.62	16.25
<i>pcr</i>	112.14	113.40	135.99	178.51	85.05
<i>sgr</i>	31.18	70.17	80.43	83.32	43.19
<i>ofd</i>	75.48	107.74	129.71	139.62	79.27

<i>b_t</i>	43.04	80.86	106.48	141.15	171.09
<i>tex</i>	5.48	10.83	15.90	20.67	16.97
<i>wap</i>	54.29	91.40	109.27	177.19	131.64
<i>lea</i>	9.97	21.41	29.00	34.21	24.71
<i>lum</i>	5.79	8.65	9.30	11.83	7.00
<i>ppp</i>	6.75	10.09	10.85	13.80	8.16
<i>p_c</i>	21.13	26.62	37.81	41.66	55.27
<i>chm</i>	62.11	93.53	114.97	125.70	88.42
<i>bph</i>	41.45	62.42	76.72	83.89	59.01
<i>rpp</i>	20.73	31.22	38.37	41.96	29.51
<i>nmm</i>	0.01	0.01	0.01	0.01	0.01
<i>i_s</i>	0.87	0.80	1.20	1.64	1.30
<i>nfm</i>	0.42	0.39	0.58	0.79	0.63
<i>fmp</i>	0.82	0.75	1.13	1.54	1.22
<i>ele</i>	1.07	1.72	3.93	10.25	15.81
<i>eeq</i>	0.42	0.68	1.54	4.01	6.19
<i>ome</i>	1.14	1.84	4.21	10.96	16.91
<i>mvh</i>	2.00	3.22	7.34	19.11	29.49
<i>otn</i>	0.53	0.86	1.97	5.12	7.90
<i>omf</i>	5.22	7.22	19.20	26.88	27.15
<i>ely</i>	0.01	0.01	0.01	1.56	2.47
<i>gdt</i>	0.01	0.01	0.01	0.00	0.00
<i>wtr</i>	17.39	10.70	26.62	27.13	17.26
<i>cns</i>	0.01	0.01	0.01	0.01	0.01
<i>trd</i>	0.86	1.99	4.38	14.38	50.02
<i>afs</i>	12.36	39.88	96.98	116.46	258.98
<i>otp</i>	21.28	47.92	80.36	118.31	107.99
<i>wtp</i>	0.00	0.00	0.01	0.01	0.01
<i>atp</i>	0.02	0.05	0.09	0.13	0.12
<i>whs</i>	4.23	9.54	15.99	23.54	21.49
<i>cmn</i>	12.04	32.27	43.23	60.82	63.77
<i>ofi</i>	0.01	0.01	0.01	0.01	0.01
<i>ins</i>	0.01	0.01	0.01	0.01	0.01
<i>rsadwe</i>	1.42	2.62	2.62	5.34	2.12
<i>obs</i>	1.11	1.61	2.62	4.15	2.47
<i>ros</i>	3.12	18.72	41.88	107.20	408.46
<i>osg</i>	0.01	0.01	0.01	0.01	0.01
<i>edu</i>	76.93	130.56	214.55	298.90	212.07
<i>hht</i>	48.39	94.81	156.54	224.68	196.15

HEADER WTF (Factor use by Activity)

We use the SAM data referring to labour/factor use by activity extracted from step 2. The data from SAM Factors * SAM Activities is modified to create a MyGTAP readable format (MyGTAP Factors * GTAP sectors/activities). The steps involved in this process are:

1. Mapping SAM factors to MyGTAP Factors and recalibrating the factor use values by activity based on the MyGTAP factors.
2. Mapping SAM activities to GTAP sectors and recalculating the factor use values based on the GTAP sectors.
3. Using this final MyGTAP factor * GTAP sectors value to evaluate factor use by activity/WTF in our MyGTAP model.

Mapping SAM factors to MyGTAP factors

After our initial SAM literature/data review we not only create a set of all relevant households for LDC countries but also do the same with respect to factors/labour commodities. Refer Appendix B to identify exhaustive list of the same used in our MyGTAP model.

In the factor mapping step we first look at the SAM factor and its description and based on the same map them with our MyGTAP factors. During this mapping we use the initial labour wage bills from GTAP aggregate database and map them with the relevant SAM sectors, and then use the weights to distribute the SAM value according to the new MyGTAP factors.

Below is sample example from Uganda's SAM table

Table 6: Sample example from Uganda's SAM - factor use by activity raw SAM data

SAM Factor Codes	SAM Factor Description	MyGTAP Factor Codes	amaiz	asorg	Arice	aocer	apuls
<i>flab-rn</i>	Labor - rural uneducated	runskl_agri	64.3	7.5	0.5	1.1	4.7
<i>flab-rp</i>	Labor - rural primary	runskl_servic	47.3	21.1	46.8	0.8	46.5
<i>flab-rs</i>	Labor - rural secondary	runskl_clerks	27.6	9.3	5.5	0.5	14.8
<i>flab-rt</i>	Labor - rural tertiary	rskl_tech_aspros/ofc_managers	0.7	0.9	0.0	0.0	3.7
<i>flab-un</i>	Labor - urban uneducated	uunskl_agri	1.6	0.7	0.0	0.0	2.2
<i>flab-up</i>	Labor - urban primary	uunskl_servic	4.2	1.0	0.4	0.1	2.6
<i>flab-us</i>	Labor - urban secondary	uunskl_clerks	3.2	0.9	0.6	0.1	4.3
<i>flab-ut</i>	Labor - urban tertiary	uskl_tech_aspros/ofc_managers	0.9	1.9		0.0	2.2

Table 7: Example wage bills as in GTAP and weights used for skilled labour sector for Uganda following the above table.

Labor Factors	Wage Bills in GTAP	Weights for skilled sectors
<i>skl_tech_asp/ Skilled Tech Aspros</i>	1176.41	0.34
<i>unskl_servic/ Unskilled Service or shop owners</i>	1420.03	
<i>unskl_clerks/ Unskilled Clerks</i>	1093.87	
<i>skl_ofcmnger / Skilled Office Managers</i>	2262.24	0.66
<i>skl_agrunskl/ Unskilled Agriculture Labor</i>	5352.07	

Table 8: Recalibrate SAM Activity factor use values based on the MyGTAP factors.

MyGTAP Factors	SAM Activities					
		<i>amaiz</i>	<i>asorg</i>	<i>arice</i>	<i>Aocer</i>	<i>Apuls</i>
<i>rskl_tech_as</i>		0.240942	0.294975	0.016688	0.004305	1.260039
<i>uskl_tech_as</i>		0.3008	0.64982	0	0.005374	0.742808
<i>runskl_servi</i>		47.34072	21.05805	46.7771	0.845828	46.5203
<i>uunskl_servi</i>		4.231418	0.971163	0.372813	0.075602	2.591885
<i>runskl_clerk</i>		27.56384	9.260207	5.450836	0.492478	14.76345
<i>uunskl_clerk</i>		3.233411	0.906804	0.612923	0.057771	4.33165
<i>rskl_ofn_man</i>		0.463333	0.56724	0.032091	0.008278	2.423065
<i>uskl_ofn_man</i>		0.57844	1.249608	0	0.010335	1.428425
<i>runskl_agri</i>		64.33554	7.483466	0.452665	1.149471	4.71736
<i>uunskl_agri</i>		1.642084	0.740626	0.04322	0.029339	2.192094

Once the SAM factors are mapped in MyGTAP readable format, step 2 and 3 are the same as the WTC process. Thus, we finally have a MyGTAP readable format of factor use by activity values extracted and recalibrated from the initial SAM factor use data.

HEADER OWNWGT (Factor Ownership Shares)

We use the SAM data referring to labour/factor ownership share for households extracted. The data from SAM Factors * SAM Households is modified to create a MyGTAP readable format (MyGTAP Factors * SAM/MyGTAP Households). Below steps indicate the mapping of SAM's factor ownership share values to MyGTAP's format:

1. Mapping SAM to MyGTAP factors and recalibrating the factor ownership values by households. Note that both SAM and MyGTAP have 1:1 household mapping, and hence do not require recalibration.
2. Recalculating the factor ownership household values based on the GTAP Agg shares and MyGTAP factor mapping.
3. Using this final MyGTAP actor * SAM/MyGTAP Households value to evaluate factor use by activity/WTF in our MyGTAP model.

Table 9: Excerpt from Sudan's SAM table - factor ownership shares calibrated to match the final MyGTAP OWNWGT format

GTAP Primary Factors	Shares				
<i>skl_tech_asp</i>	0.4				
<i>unskl_servic</i>	0.6				
<i>unskl_clerks</i>	0.4				
<i>skl_ofcmnger</i>	0.6				
<i>skl_agrunskl(UNSK_AGRI)</i>	1.0				

SAM Factors	Mapping with GTAP Factors	hurbQ1	hurbQ2	hrurQ1	hrurQ2
<i>Labor - urban male skilled</i>	mutech/ofcman	4.1	9.7	0	0
<i>Labor - urban male semi-skilled</i>	muclerks/ser	14.0	30.9	0	0
<i>Labor - urban male unskilled</i>	Muagri	3.1	6.0	0	0
<i>Labor - urban female skilled</i>	wutech/ofcmanager	1.7	3.4	0	0
<i>Labor - urban female semi-skilled</i>	wuclerks/ser	2.1	4.1	0	0
<i>Labor - urban female unskilled</i>	Wuagri	0.7	1.4	0	0
<i>Labor - rural male skilled</i>	mrtech/ofcman	0.0	0.0	2.0	2.4
<i>Labor - rural male semi-skilled</i>	mrclerks/ser	0.0	0.0	32.2	45.5
<i>Labor - rural male unskilled</i>	Mragri	0.0	0.0	8.2	10.5
<i>Labor - rural female skilled</i>	wrtech/ofcmanager	0.0	0.0	0.5	0.5
<i>Labor - rural female semi-skilled</i>	wrclerks/ser	0.0	0.0	5.6	6.1
<i>Labor - rural female Unskilled</i>	Wragri	0.0	0.0	1.0	1.0
Final MyGTAP Factors		hurbQ1	hurbQ2	hrurQ1	hrurQ2
<i>mrskl_tech_a</i>		0.0	0.0	0.9	1.1
<i>muskl_tech_a</i>		1.8	4.3	0.0	0.0
<i>wrskl_tech_a</i>		0.0	0.0	0.2	0.2
<i>wuskl_tech_a</i>		0.7	1.5	0.0	0.0
<i>mrunskl_serv</i>		0.0	0.0	17.9	25.3
<i>muunskl_serv</i>		7.8	17.2	0.0	0.0
<i>wrunskl_serv</i>		0.0	0.0	3.1	3.4
<i>wuunskl_serv</i>		1.2	2.3	0.0	0.0
<i>mrunskl_cler</i>		0.0	0.0	14.3	20.2
<i>muunskl_cler</i>		6.2	13.7	0.0	0.0
<i>wrunskl_cler</i>		0.0	0.0	2.5	2.7
<i>wuunskl_cler</i>		0.9	1.8	0.0	0.0
<i>mrskl_ofn_ma</i>		0.0	0.0	1.1	1.3
<i>muskl_ofn_ma</i>		2.3	5.4	0.0	0.0
<i>wrskl_ofn_ma</i>		0.0	0.0	0.3	0.3
<i>wuskl_ofn_ma</i>		0.9	1.9	0.0	0.0
<i>mrunskl_agri</i>		0.0	0.0	8.2	10.5
<i>muunskl_agri</i>		3.1	6.0	0.0	0.0
<i>wrunskl_agri</i>		0.0	0.0	1.0	1.0
<i>wuunskl_agri</i>		0.7	1.4	0.0	0.0

MODEL SPECIFICATION AND SIMULATIONS

The database obtained is used to simulate selected policy scenarios that include the Covid-crisis effects on LDCs product and employment composition.

DRAFT: NOT FOR PUBLICATION

APPENDIX

APPENDIX A

Household types as obtained from the SAM data mapped to MyGTAP Household types:

<i>HHCode</i>	<i>Country</i>	<i>HHSplitHAR</i>
<i>Small Farmer</i>	Bangladesh	Sfarmer
<i>Medium Farmer</i>	Bangladesh	Mfarmer
<i>Large Farmer</i>	Bangladesh	Lfarmer
<i>Non-Farm SE</i>	Bangladesh	NonFarmSE
<i>Non-Farm WE</i>	Bangladesh	NonFarmWSE
<i>Day labour</i>	Bangladesh	Daylabour
<i>Salaried</i>	Bangladesh	Salaried
<i>Self-employed</i>	Bangladesh	SelfEmployed
<i>Rural poor households</i>	Burkina Faso	RPoorHHs
<i>Urban poor households</i>	Burkina Faso	UPoorHHs
<i>Rural non-poor households</i>	Burkina Faso	RNPoorHHs
<i>Urban non-poor households</i>	Burkina Faso	UNPoorHHs
<i>Rural farm - quintile 1</i>	Ethiopia, Malawi, Mozambique, Tanzania, Uganda	RuralFarmQ1
<i>Rural farm - quintile 2</i>	Ethiopia, Malawi, Mozambique, Tanzania, Uganda	RuralFarmQ2
<i>Rural farm - quintile 3</i>	Ethiopia, Malawi, Mozambique, Tanzania, Uganda	RuralFarmQ3
<i>Rural farm - quintile 4</i>	Ethiopia, Malawi, Mozambique, Tanzania, Uganda	RuralFarmQ4
<i>Rural farm - quintile 5</i>	Ethiopia, Malawi, Mozambique, Tanzania, Uganda	RuralFarmQ5
<i>Rural nonfarm - quintile 1</i>	Ethiopia, Malawi, Mozambique, Tanzania, Uganda	RuralNFarmQ1
<i>Rural nonfarm - quintile 2</i>	Ethiopia, Malawi, Mozambique, Tanzania, Uganda	RuralNFarmQ2
<i>Rural nonfarm - quintile 3</i>	Ethiopia, Malawi, Mozambique, Tanzania, Uganda	RuralNFarmQ3
<i>Rural nonfarm - quintile 4</i>	Ethiopia, Malawi, Mozambique, Tanzania, Uganda	RuralNFarmQ4
<i>Rural nonfarm - quintile 5</i>	Ethiopia, Malawi, Mozambique, Tanzania, Uganda	RuralNFarmQ5
<i>Urban - quintile 1</i>	Ethiopia, Malawi, Mozambique, Tanzania, Uganda	UrbanQ1
<i>Urban - quintile 2</i>	Ethiopia, Malawi, Mozambique, Tanzania, Uganda	UrbanQ2
<i>Urban - quintile 3</i>	Ethiopia, Malawi, Mozambique, Tanzania, Uganda	UrbanQ3

<i>Urban - quintile 4</i>	Ethiopia, Malawi, Mozambique, Tanzania, Uganda	UrbanQ4
<i>Urban - quintile 5</i>	Ethiopia, Malawi, Mozambique, Tanzania, Uganda	UrbanQ5
<i>Urban</i>	Guinea Bissau, Rwanda	Urban
<i>Rural</i>	Guinea Bissau, Rwanda	Rural
<i>Rural - wage</i>	Lesotho	RuralWage
<i>Rural - Farm</i>	Lesotho	RuralFarm
<i>Rural - Other</i>	Lesotho	RuralOther
<i>Urban - Skilled wage</i>	Lesotho	UrbanSkilled
<i>Urban - Unskilled wage</i>	Lesotho	UrbanUnskilled
<i>Urban - Other</i>	Lesotho	UrbanOther
<i>Rural D1</i>	Senegal	RuralD1
<i>Rural D2</i>	Senegal	RuralD2
<i>Rural D3</i>	Senegal	RuralD3
<i>Rural D4</i>	Senegal	RuralD4
<i>Rural D5</i>	Senegal	RuralD5
<i>Rural D6</i>	Senegal	RuralD6
<i>Rural D7</i>	Senegal	RuralD7
<i>Rural D8</i>	Senegal	RuralD8
<i>Rural D9</i>	Senegal	RuralD9
<i>Rural D10</i>	Senegal	RuralD10
<i>Urbain D1</i>	Senegal	UrbainD1
<i>Urbain D2</i>	Senegal	UrbainD2
<i>Urbain D3</i>	Senegal	UrbainD3
<i>Urbain D4</i>	Senegal	UrbainD4
<i>Urbain D5</i>	Senegal	UrbainD5
<i>Urbain D6</i>	Senegal	UrbainD6
<i>Urbain D7</i>	Senegal	UrbainD7
<i>Urbain D8</i>	Senegal	UrbainD8
<i>Urbain D9</i>	Senegal	UrbainD9
<i>Urbain D10</i>	Senegal	UrbainD10
<i>hurbQ1</i>	Sudan, Zambia	hurbQ1
<i>hurbQ2</i>	Sudan, Zambia	hurbQ2
<i>hurbQ3</i>	Sudan, Zambia	hurbQ3
<i>hurbQ4</i>	Sudan, Zambia	hurbQ4
<i>hurbQ5</i>	Sudan, Zambia	hurbQ5
<i>hrurQ1</i>	Sudan, Zambia	hurbQ6
<i>hrurQ2</i>	Sudan, Zambia	hurbQ7
<i>hrurQ3</i>	Sudan, Zambia	hurbQ8
<i>hrurQ4</i>	Sudan, Zambia	hurbQ9
<i>hrurQ5</i>	Sudan, Zambia	hurbQ10
<i>Public Employees</i>	Togo	PublicEmp
<i>Formal Private Employees</i>	Togo	FormalPrivateE

<i>Informal Private Employees</i>	Togo	InformalPrivateE
<i>Independent Farmers</i>	Togo	IndependentFar
<i>Self Employed and Non Agricultural Employers</i>	Togo	SelfAgriculturalE
<i>Inactive</i>	Togo	Inactive
<i>z1hhdf</i>	Yemen	z1hhdf
<i>z1hhdnf</i>	Yemen	z1hhdnf
<i>z1hhdu</i>	Yemen	z1hhdu
<i>z2hhdf</i>	Yemen	z2hhdf
<i>z2hhdnf</i>	Yemen	z2hhdnf
<i>z2hhdu</i>	Yemen	z2hhdu
<i>z3hhdf</i>	Yemen	z3hhdf
<i>z3hhdnf</i>	Yemen	z3hhdnf
<i>z3hhdu</i>	Yemen	z3hhdu
<i>z4hhdf</i>	Yemen	z4hhdf
<i>z4hhdnf</i>	Yemen	z4hhdnf
<i>z4hhdu</i>	Yemen	z4hhdu

APPENDIX B

Factor types as obtained from the SAM data and the final factor types in MyGTAP:

<i>Original SAM Labor Types</i>	<i>Explanation</i>	<i>Country</i>	<i>Factor as in MyGTAP</i>
<i>Flurmsk</i>	Labor - urban male skilled	Sudan	mrskl_tech_aspros
<i>Flurmsm</i>	Labor - urban male semi-skilled	Sudan	muskl_tech_aspros
<i>Flurmun</i>	Labor - urban male unskilled	Sudan	wrskl_tech_aspros
<i>flurfesk</i>	Labor - urban female skilled	Sudan	wuskl_tech_aspros
<i>Flurfesm</i>	Labor - urban female semi-skilled	Sudan	rskl_tech_aspros
<i>flurfeun</i>	Labor - urban female unskilled	Sudan	uskl_tech_aspros
<i>Flurmsk</i>	Labor - rural male skilled	Sudan	mskl_tech_aspros
<i>Flurmsm</i>	Labor - rural male semi-skilled	Sudan	wskl_tech_aspros
<i>Flurmun</i>	Labor - rural male unskilled	Sudan	mrunkl_servic
<i>flrufesk</i>	Labor - rural female skilled	Sudan	muunkl_servic
<i>flrufesm</i>	Labor - rural female semi-skilled	Sudan	wrunskl_servic
<i>lab-rn</i>	Labor - rural uneducated	Tanzania	wuunkl_servic
<i>lab-rp</i>	Labor - rural primary	Tanzania	runskl_servic
<i>lab-rs</i>	Labor - rural secondary	Tanzania	uunkl_servic
<i>lab-rt</i>	Labor - rural tertiary	Tanzania	munkl_servic

<i>lab-un</i>	Labor - urban uneducated	Tanzania		wunskl_servic
<i>lab-up</i>	Labor - urban primary	Tanzania		mrunkl_clerks
<i>lab-us</i>	Labor - urban secondary	Tanzania		muunkl_clerks
<i>lab-ut</i>	Labor - urban tertiary	Tanzania		wrunskl_clerks
<i>Travail rural femme</i>	Rural- Woman	Togo		wuunkl_clerks
<i>Travail rural homme</i>	Rural-Man	Togo		runskl_clerks
<i>Travail urbain femme qualifiée</i>	Urban - Skilled Woman	Togo		uunkl_clerks
<i>Travail urbain femme non qualifiée</i>	Urban - Unskilled Woman	Togo		munkl_clerks
<i>Travail urbain homme qualifié</i>	Urban - Skilled Man	Togo		wunskl_clerks
<i>Travail urbain homme non qualifié</i>	Urban - Unskilled Man	Togo		muskl_ofn_manager
				mrskl_ofn_manager
				wrskl_ofn_manager
				wuskl_ofn_manager
				rskl_ofn_manager
				uskl_ofn_manager
				mskl_ofn_manager
				wskl_ofn_manager
				mrunkl_agri
				muunkl_agri
				wrunskl_agri
				wuunkl_agri
				runskl_agri
				uunkl_agri
				munkl_agri
				wunskl_agri

<i>z4hhdnf</i>	Yemen	z4hhdnf
<i>z4hhdu</i>	Yemen	z4hhdu