1 Distributional Analysis: Consumer Incidence (Compensating Variation) and distributional effects of revenue recycling

1.1 Mapping Consumption categories to GLORIA sectors

To assess how sectoral price changes translate into consumer price changes, consumption categories are mapped to corresponding GLORIA sectors. This process involves two steps: firstly, matching CPAT consumption categories with the corresponding GTAP-10 Sectors using the mapping based on the CPAT-Guidebook and secondly, mapping GTAP-10 categories with the corresponding GLORIA sectors. The combined concordance table GLORIA-consumption categories is created in dataprep.py, which then will be used as input for all other parts.

Assumption 1:
The price change of any good within a GLORIA/GTAP sector is equal to the price change of the aggregate sector.

Assumption 2:
The relative share of GTAP/GLORIA sectors within overlapping CPAT consumption category g is proportional to the share of this GLORIA sector in the final household demand. Thus, a consumption category's overall price change is a weighted average of the corresponding sectors' final demand values.

1.2 Baseline Incidence (goods and services):

Assuming full cost pass-through and cost-push of the upstream carbon tax, only a domestic carbon policy (BTA optional), no structural change in the economy due to taxes (no changed technical coefficients), no behavioural response to the price changes and no revenue recycling scheme, the incidence is measured in terms of compensating variation (CV) (measures how much expenses need to be increased when consumer prices rise such that consumption remains at its pre-policy level This scenario represents an upper bound of short-term consumption effects in terms of compensating variation (fixed expenditure patterns).

To calculate the per capita tax incidence per decile, the baseline final household demand from GLORIA (irrespective of origin) per **sector is disaggregated using microdata information on budget shares and total budget** by decile/category. To calculate the implied decile-specific pre-policy per capita expenditures, first the sectoral demand is split up according to the GLORIA-consumption category concordance table.[1]

$$\textbf{1)}\quad \mathbf{final\_demand_G} = \sum_S \mathbf{final\_demand_S} \quad \forall\, \mathbf{S} \in \mathbf{G}$$

Decile expenditure shares per category **G** [2]are defined as:

$$\textbf{2)}\quad \mathbf{exp\_share\_DG} = \frac{\boldsymbol{\pi_{DG}} * \mathbf{cons\_pc\_acrent_D}}{\sum_D \boldsymbol{\pi_{DG}} * \mathbf{cons\_pc\_acrent_D}}$$

[1] For the few expenditure categories which are mapped to common sectors the demand of sector S is weighted by the pre-policy expenditure shares $\frac{\boldsymbol{\pi_G}}{\sum_{G \leftrightarrow S} \boldsymbol{\pi_G}}$ of all G to which a common sector S is mapped to.

[2] How much of aggregate expenditures for category **G** is attributable to decile **D**

where $\boldsymbol{\pi_{DG}}$ denotes the share of total HH expenditures of the average household in decile **D** for consumption good **G** and $\mathbf{cons\_pc\_acrent_D}$ denotes the sum of all household expenditures of decile **D** (both from the microdata). The total expenditures for G per D then reads:

$$\mathbf{3)}\quad \mathbf{exp\_total_{DG}} = \mathbf{exp\_share_{DG}} * \mathbf{final\_demand_G}$$

Per capita expenditures, avg. household in decile D, per consumption category G, follow by taking the population of the

year into account:

$$\mathbf{4)}\quad \mathbf{exp_{pc_{DG}}} = \frac{\mathbf{exp\_total_{DG}}}{\frac{1}{10}\mathbf{population\ 2019}}$$

The policy-induced price change of expenditure category **G** then is the weighted average of the sectoral price changes (from MINDSET results) within an expenditure category G.

$$\mathbf{5)}\quad \Delta\mathbf{p_G} = \sum_s \boldsymbol{weight_{SG}} * \Delta\mathbf{p_S}\ \ \boldsymbol{S} \in \mathbf{G}$$

$$\mathbf{6)}\quad \boldsymbol{weight_{SG}} = \frac{\mathbf{final\_demand_S}}{\sum_{S \in G} \mathbf{final\_demand_S}}\ \ \mathbf{S} \in \mathbf{G}$$

The baseline consumer incidence of an upstream carbon tax under the assumption of full cost push and no behavioural response would then be calculated as the product of the exogenous price change of expenditure category G and the pre-policy per capita consumption of G by household D. Absolute (7) and relative tax burden (8) are then calculated as follows.

$$\mathbf{7)}\quad \mathbf{abs\_inc\_MS} = \sum_G \Delta\mathbf{p_G} * \mathbf{exp_{pc_{DG}}}$$

$$\mathbf{8)}\quad \mathbf{rel\_inc\_MS} = \sum_G \Delta\mathbf{p_G} * \frac{\mathbf{exp_{pc_{DG}}}}{\mathbf{exp\_total_{DG}}}$$

1.3 Decile specific price elasticities of demand

Households can be expected to at least partly substitute towards cheaper 1. less energy intensive goods or 2. imports from non-regulated jurisdictions, depending on own- and cross-price elasticities. CPAT adopts the countries' elasticity reported for the middle deciles (estimated by Muhammad et al. 2011 for 9 consumption categories (Food, beverages, & tobacco, Clothing & footwear, Housing, House furnishings, Medical & health, Transport & communications, Recreation, Education, Other) using 2005 ICP data) and assumes that the upper and lower deciles' elasticities will deviate from the elasticity reported by the same proportion as the elasticities for low- and high-income countries deviate from that of middle-income countries for each consumption item.

Absolute (10) and relative (11) tax burden with price-adjusted demand:

$$9)\quad \mathbf{abs\_inc\_MS\_ela} = \sum_G \Delta \mathbf{p}_G * \mathbf{exp}_{\mathbf{pc}_{DG}} * (1 + \Delta p_G)^{ela\_price_{G,D}}$$

$$10)\quad \mathbf{rel\_inc\_MS\_ela} = \sum_G \Delta \mathbf{p}_G * \frac{\mathbf{exp}_{\mathbf{pc}_{DG}}}{\mathbf{exp\_total}_{DG}} (1 + \Delta p_G)^{ela\_price_{G,D}}$$

1.4 Targeted direct transfers

The user has the option to target lower deciles for the redistribution of revenues (either via income tax cuts or through direct transfers), where all deciles equal or below the target decile **T** receive the same transfer.

$$11)\ \mathbf{targeted\_pop} = \mathbf{population2019} * \frac{\mathbf{T}}{\mathbf{10}}$$

$$12)\ \mathbf{pc\_transfer}_{D \leq T} = \frac{\mathbf{MS\_rev\_inc}}{\mathbf{targeted\_pop}} * \mathbf{1000}$$

The per capita tax burden per decile after revenue redistribution then is proxied as the per capita tax burden less the received transfer.

1.4.1 Inputs:

Variable	Description	Dimension	Source	Unit
$\pi_{D,G}$	Average budget share of decile D for expenditure category G	D x G	HH_data_with_elas.xlsx	Share
cons_pc_acrent	Total (Annualized) HH consumption, calculated as the sum of all consumption expenditures of HH excluding all housing rent	D x 1	HH_data_with_elas.xlsx	LCU
Δp_S (MS_p)	Exogenous price change of commodity S induced by carbon tax	S x 1	**TO BE CHANGED**	Percentage change
$ela\_price_{G,D}$	Average price elasticity of demand for expenditure category G in decile D	D x G	HH_data_with_elas.xlsx	Elasticity
$final\ demand_S$ (MS_q)	Final household demand for commodity S in country of interest (irrespective of origin)	S x 1	**TO BE CHANGED**	1000 US$ 2019
concordance	Concordance table between GLORIA sectors and expenditure categories	One row for each unique	GLORIA_CPAT_concordance.xlsx (from	

		combination of S and G	GTAPtoGLORIA.xlsx and CPAT_GTAP.xlsx)	
Population 2019	Official 2019 population	Country x year	https://data.worldbank.org/indicator/SP.POP.TOTL (saved as xlsx)	
MS_rev_inc	Total revenue recycled into direct transfers or income tax cuts	S x 1	**TO BE CHANGED** (at the moment from revenue tab in Results_ISO.xlsx)	1000 US$ 2019
T	Targeted decile: Each expenditure decile equal or below T receives the same transfer	scalar	User defined	[1,10]

1.4.2 Output: (saved in xlsx files when running MASTER_household_results.py)

Output-column names	Description	Dimension	Location	Unit
abs_inc_MS	Absolute tax burden (compensating variation)	1 x Decile	Incidence.xlsx generated by save_results() in tax_burden_scaled.py	2019 US$
rel_inc_MS	Relative tax burden: percentage increase in cost of pre-policy basket	1 x Decile	Incidence.xlsx generated by save_results() in tax_burden_scaled.py	percentage change
abs_inc_MS_ela	Absolute tax burden with price reaction (compensating variation)	1 x Decile	Incidence.xlsx generated by save_results() in tax_burden_scaled.py	2019 US$
rel_inc_MS_ela	Relative tax burden with price reaction(compensating variation)	1 x Decile	Incidence.xlsx generated by save_results() in tax_burden_scaled.py	Percentage change
pc_transfer	Per capita transfer received by each decile	1 x Decile	Transfers.xlsx generated by save_results_target() in transfers.py	2019 US$
abs_inc_RR	Absolute tax burden (compensating variation) minus per capita transfer	1 x Decile	Transfers.xlsx generated by save_results_target() in transfers.py	2019 US$

rel_inc_RR	Relative tax burden including transfer	1 x Decile	Transfers.xlsx generated by save_results_target() in transfers.py	Percentage change
abs_inc_ela_RR	Absolute tax burden with price reaction (compensating variation) minus per capita transfer	1 x Decile	Transfers.xlsx generated by save_results_target() in transfers.py	2019 US$
rel_inc_ela_RR	Relative tax burden with price reaction(compensating variation) including transfer	1 x Decile	Transfers.xlsx generated by save_results_target() in transfers.py	Percentage change

1.5 Public Infrastructure investment

Proxied per-capita transfers from government spending into public infrastructure is received only by those individuals without initial access to infrastructure type **i**. CPAT-harmonized household surveys include the weighted shares of households within decile d which have access to infrastructure category **i**. The categories are access to i) water; ii) electricity; iii) sanitation; iv) ICT; and v) public transportation.

Based on the policy inputs in the tax template, where the user can specify π_S – the share of the revenue for all government spending, to be invested in GLORIA Sector **S** –, shares $\boldsymbol{\pi_i}$ are retrieved, where **S** and **i** are mapped as follows:

Infrastructure category	**GLORIA Sector**
water	95 (60%)[3]
sanitation	95 (40%), 96(20%)
electricity	93
ICT	110,111
public transport	101,102,103,104

The same mapping procedure applies to other (bulk or debt financed) investment (from public_inv.csv) into those sectors so total investment in each infrastructure category is computed as follows:

$$\textbf{13) } \mathbf{total\_investment_i} = \boldsymbol{\pi_i} * \mathbf{MS\_rev\_govt} + \mathbf{other\_investment_i}$$

The total population which benefits from the proxy transfer per infrastructure category **i** is then calculated as:

$$\textbf{14) } \mathbf{pop_i} = \sum_D \mathbf{1 - access_{share_{Di}}} * \mathbf{population/10}$$

The per capita transfer for the population without initial access to infrastructure **i** follows:

[3] 60% of total investment into GLORIA sector 95 is assumed to be invested in infrastructure category water

$$\textbf{15) } \mathbf{pc\_transfer_i} = \frac{\mathbf{total\_investment_i}}{\mathbf{pop_i}}$$

The proxy per capita transfer in each decile for each consumption category then is :

$$\textbf{16) } \mathbf{pc\_transfer_{iD}} = \sum_i \mathbf{access\_share_{Di}} * \mathbf{pc\_transfer_i}$$

1.5.1 Inputs:

Variable	Description	Dimension	Source	Unit
$\mathbf{access\_share_{Di}}$	Share of population in decile D, which has existing access to infrastructure category i	i x Decile	HH_data_with_elas.xlsx	Share
MS_rev_govt	Total tax revenue to be recycled into government sepnding	Integer	**TO BE CHANGED** (at the moment from revenue tab in Results_ISO.xlsx)	1000 2019 US$
π_S	Exogenous price change of commodity S induced by carbon tax	S x 1	Templates_tax_BTA_ISO.xlsx – govt spending tab	Percentage change
other_investment_S	Other total investment into GLORIA Sectors S – then mapped to infrastructure categories	S x 1	Public_inv.csv	1000 US$ 2019
Population 2019	Official 2019 population	Country x year	https://data.worldbank.org/indicator/SP.POP.TOTL (saved as xlsx)	

1.5.2 Output: (saved in public_infr.xlsx files when running MASTER_household_results.py)

Output-column names	Description	Dimension	Location	Unit
Per_cap_transfer_i	Proxied per capita transfer per infrastructure category i and decile D	i x Decile	public_inf.xlsx generated by save_results_public() in transfers.py	2019 US$
total_publ_infr_transfer	Sum of per capita transfers over infrastructure categories per decile	1 x Decile	Incidence.xlsx generated by save_results() in tax_burden_scaled.py	2019 US$

1.5.3 Equations and Functions: Documentation in pdf

Equation	Function	Location	Calls on
1)	**calc_tot_demand_g**(country, HH_data, MS_q, concordance)	auxiliary.py l. 144	petroleum_coke_frs_shares
2)	**calc_pc_exp_dg**(country, HH_data, MS_q, concordance , pop_data)	auxiliary.py l.269	calc_tot_demand_g, get_pop
3)	**calc_pc_exp_dg**(country, HH_data, MS_q, concordance , pop_data)	auxiliary.py l.273	calc_tot_demand_g, get_pop
4)	**calc_pc_exp_dg**(country, HH_data, MS_q, concordance , pop_data)	auxiliary.py l.277	calc_tot_demand_g, get_pop
5)	**calc_price_changes**(MS_q, MS_p, concordance)	auxiliary.py l.51-91	calculate_sectorshares
6)	**calculate_sectorshares**(MS_q, concordance)	Auxiliary.py l. 5-48	-
7)	**tax_burden_MS**(country, HH_data, MS_q, MS_p, concordance , pop_data)	tax_burden _scaled.py l. 99	calc_pc_exp_dg, calc_price_changes
8)	**tax_burden_MS**(country, HH_data, MS_q, MS_p, concordance , pop_data)	tax_burden _scaled.py l. 101	calc_pc_exp_dg, calc_price_changes
9)	**tax_burden_MS**(country, HH_data, MS_q, MS_p, concordance , pop_data)	tax_burden _scaled.py l. 111	calc_pc_exp_dg, calc_price_changes
10)	**tax_burden_MS**(country, HH_data, MS_q, MS_p, concordance , pop_data)	tax_burden _scaled.py l. 112	calc_pc_exp_dg, calc_price_changes
11)	**targeted_transfer**(country, HH_data, MS_q, MS_p, MS_rev_inc,concordance,pop_ data, decile_target)	transfers.py l. 48	tax_burden_MS , get_pop
12)	**targeted_transfer**(country, HH_data, MS_q, MS_p, MS_rev_inc,concordance,pop_ data, decile_target)	transfers.py l. 50-65	tax_burden_MS , get_pop
13)	**public_investment**(country, HH_data, MS_rev_govt, shares,	transfers.py l. 119-121	get_pop, get_other_investment, get_publ_inv_shares

	countrynames, public_inv , pop_data)		
14)	**public_investment**(country, HH_data, MS_rev_govt, shares, countrynames, public_inv , pop_data)	transfers.py l. 117	get_pop, get_other_investment, get_publ_inv_shares
15)	**public_investment**(country, HH_data, MS_rev_govt, shares, countrynames, public_inv , pop_data)	transfers.py l. 119	get_pop, get_other_investment, get_publ_inv_shares
16)	**public_investment**(country, HH_data, MS_rev_govt, shares, countrynames, public_inv , pop_data)	transfers.py l. 124-128	get_pop, get_other_investment, get_publ_inv_shares

2 Decile specific household demand reactions on price and income changes

In its current version MINDSET models households demand reaction to tax-induced price changes of consumer goods with USDA-based own- and cross price elasticities of demand (estimated in Muhammad et al. 2011) for one representative household. Since a countries aggregate demand adjustment in response to price shocks depends both on the distribution of total expenditures and differing substitution opportunities across the income/expenditure spectrum, we can make use of pre-harmonized Microdata containing information on decile- and country specific expenditure patterns and (own)-price elasticities of demand.

2.1 Price Adjustment Factors

The **price adjustment factors –** the after policy final demand as a percentage of pre-policy final demand (0 and 1 since all price elasticities in data are negative) - are calculated with decile (**D**) - and expenditure category (**G**) specific own-price elasticities and price changes per consumption category **G** – calculated from sectoral price changes per GLORIA Sector S (weighted average between price changes of imports and domestically produced goods).

To map the price changes of 120 into the price changes of the 25 expenditure categories, the price changes of each sector **S** corresponding to an expenditure category **G** (with a concordance table between GLORIA sectors and expenditure categories), are weighted by their shares of total household demand within **G.**

The price change of expenditure category **G** then calculates as follows:

$$\textbf{1)}\quad \Delta \mathbf{p_G} = \sum_s \boldsymbol{weight_{SG}} * \Delta \mathbf{p_S}\ , \boldsymbol{S} \in \mathbf{G}$$

$$\textbf{2)}\quad \boldsymbol{weight_{SG}} = \frac{\boldsymbol{final\ demand_s}}{\sum_{S \in G} \boldsymbol{final\ demand_s}}\ , \mathbf{S} \in \mathbf{G}$$

The price adjustment factors per decile **D** and expenditure category **G** are then calculated as:

$$\textbf{3)}\quad \mathbf{adj\_factor_{price}}\boldsymbol{DG} = (\mathbf{1} + \Delta \boldsymbol{p_G})^{\boldsymbol{ela\_price_{G,D}}}$$

The aggregated reaction to prices $\Delta \boldsymbol{p_G}$ per consumption category G can be expressed as the weighted average of decile specific price demand adjustment factors, weighted by the proportion of total expenditures of the avg. household of each decile for that category, calculated with the decile specific expenditure shares $\boldsymbol{\pi_{D,G}}$ from the microdata.

$$\textbf{4)}\quad \mathbf{adj\_factor_{price}}\boldsymbol{G} = \sum_{D=10} \mathbf{adj\_factor_{price}}\boldsymbol{DG} * \frac{\boldsymbol{\pi_{D,G}} * \mathbf{cons\_pc\_acrent_D}}{\sum_D \boldsymbol{\pi_{D,G}} * \mathbf{cons\_pc\_acrent_D}}$$

The price demand adjustment factor is then assigned to the corresponding GLORIA sector S

$$5)\quad \mathbf{adj\_factor_{price}}\boldsymbol{S} = \mathbf{adj\_factor_{price}}\boldsymbol{G} \quad \forall\, \boldsymbol{G} \in \boldsymbol{S}$$

For the expenditure categories which are mapped to common sectors[4] the adjustment factor is again weighted by the pre-policy expenditure shares of the average households $\boldsymbol{\pi_{D,G}}$ within sectors S. Example for expenditure categories charcoal and firewood (GLORIA sector 21):

$$6)\quad \mathbf{adj_{factor_{price}}}\boldsymbol{S}\mathbf{21} = \frac{\boldsymbol{\pi_{CCL}}}{\boldsymbol{\pi_{CCL}}+\boldsymbol{\pi_{FWD}}} * \mathbf{adj_{factor_{price}}CCL} + \frac{\boldsymbol{\pi_{CCL}}}{\boldsymbol{\pi_{CCL}}+\boldsymbol{\pi_{FWD}}} * \mathbf{adj\_factor_{price}FWD}$$

2.2 Input Data / Output variables and functions

2.2.1 Input variables

The input variables are listed as named in the formulas: They have different names in the code. Household microdata and mappings can be found under: ONEDRIVELINK

Variable	Description	Dimension	Source	Unit
$\boldsymbol{\pi_{D,G}}$	Average budget share of decile D for expenditure category G	D x G	HH_data_with_elas.xlsx	Share
$\boldsymbol{\Delta p_S}$ **(MS_p)**	Exogenous price change of commodity S induced by carbon tax	S x 1	**TO BE CHANGED**	Percentage change
$\boldsymbol{ela\_price_{G,D}}$	Average price elasticity of demand for expenditure category G in decile D	D x G	HH_data_with_elas.xlsx	Elasticity
$\boldsymbol{final\ demand_S}$ **(MS_q)**	Final household demand for commodity S in country of interest (irrespective of origin)	S x 1	**TO BE CHANGED**	1000 US$ 2019
concordance	Concordance table between GLORIA sectors and expenditure categories	One row for each unique combination of S and G	GLORIA_CPAT_concordance.xlsx (from GTAPtoGLORIA.xlsx and CPAT_GTAP.xlsx)	

[4] ccl, fwd : both mapped to GLORIA sector 21 (forestry and logging) and die, ethanol, gso, ker, lpg mapped to GLORIA sectors 62,63 (Coke oven products , refined petroleum products)

2.2.2 Output: (when calling HHdemand_adjustments_price_GLORIA with inputs)

Variable	Description	Dimension	Source	Unit
adj_factor_{price}	Income adjustment factor of demand per GLORIA sector S given price changes : Multiplied with pre-policy demand to retrieve hh demand after price changes	S x 1	HHdemand_adjustments_income_GLORIA	Factor

2.2.3 Equations and Functions: Documentation in pdf

Equation	Function	Location	Calls on
1)	**calc_price_changes**(MS_q, MS_p, concordance)	sector_adj_factors.py l. 394-434	calculate_sectorshares
2)	**calculate_sectorshares**(MS_q, concordance)	sector_adj_factors.py l.347-391	-
3)	**get_weighted_price_adj_factors**(country, HH_data, MS_q, MS_p, concordance)	sector_adj_factors.py l. 81	calc_price_changes
4)	**get_weighted_price_adj_factors**(country, HH_data, MS_q, MS_p, concordance)	sector_adj_factors.py l. 98	calc_price_changes
5)	**HHdemand_adjustments_price_GLORIA**(country, HH_data, MS_q, MS_p, concordance)	sector_adj_factors.py l.107-171	get_weighted_price_adj_factors, petroleum_coke_frs_shares
6)	**petroleum_coke_frs_shares**(country, HH_data)	sector_adj_factors.py l. 437-481	-

2.3 Income adjustment factors

When redistributing the revenues from a carbon tax via direct monetary transfers to households – through income tax cuts or lump-sum transfers- the aggregate increase in household demand due to an increase in disposable income again depends on the different consumption patterns and income-elasticities of demand across a countries income distribution. The user has the option to distribute

the revenues to lower deciles only, where the revenues are equally redistributed to deciles below or equal the target decile **T**.[5]

Using the pre-harmonized microdata, **income-adjustment factors** – the factor by which pre-policy final demand is scaled to obtain the post-income effect demand – are calculated for each pair of decile D and consumption category G:

First, the revenues recycled into each targeted decile are calculated:

$$\textbf{(1)}\ \ \mathbf{delta_{inc_d}} = \ \mathbf{MS\_rev\_inc} * \frac{\mathbf{1}}{\mathbf{T}}$$

The effect of increased the disposable income (the total transfer received by decile D) on the demand of Household D for expenditure category G (income-adjustment factor) then reads:

$$\textbf{(2)}\ \ \mathbf{adj\_factor_{inc}}\boldsymbol{DG} \ = \ (\mathbf{1} + (\frac{\mathbf{delta\_inc_D}}{\mathbf{total\ expenditures_D}})^{\mathbf{ela\_inc}_{\boldsymbol{G,D}}}$$

The total expenditures per decile and consumption category are calculated with the final household demand vector for good G where the total demand of an expenditure category G (calculated as in 1)) is split up between deciles according to the deciles pre-policy share of total expenditures calculated from the microdata on expenditure shares ($\boldsymbol{\pi_{D,G}}$) and absolute expenditures (**cons_pc_acrent**).

$$\textbf{(3)}\ \ \mathbf{total\ expenditures_D} \ = \ \sum_{\boldsymbol{G}} \mathbf{total\ expenditures_{DG}}$$

$$\textbf{(4)}\ \ \mathbf{total\ expenditures_{DG}} \ = \ \frac{\boldsymbol{\pi_{D,G}} * \mathbf{cons\_pc\_acrent_D}}{\sum_D \boldsymbol{\pi_{D,G}} * \mathbf{cons\_pc\_acrent_D}} * \mathbf{final\_demand_G}$$

The income-adjustment factor of category G follows by aggregating the decile demand changes weighted by the deciles pre-policy share of total expenditures for category G for each decile, where the income adjustment factor of untargeted deciles equals 1.

$$\textbf{(5)}\ \ \mathbf{adj\_factor_{inc}}\boldsymbol{G} \ = \ \sum_{\mathbf{D=10}} \mathbf{adj\_factor_{inc}}\boldsymbol{DG} * \frac{\boldsymbol{\pi_{D,G}} * \mathbf{cons\_pc\_acrent_D}}{\sum_D \boldsymbol{\pi_{D,G}} * \mathbf{cons\_pc\_acrent_D}}$$

Similar to the aggregation of price adjustment factors of demand, the income adjustment factors of each consumption category G are assigned to the corresponding GLORIA sectors S:

$$\textbf{(6)}\ \ \mathbf{adj\_factor_{inc}}\boldsymbol{S} = \ \mathbf{adj\_factor_{inc}}\boldsymbol{G} \quad \forall\ \boldsymbol{G} \in \boldsymbol{S}$$

[5] T is set to 10 on default – equivalent to a lump-sum transfer for the whole population

For the few expenditure categories G which are mapped to one common sector[6], the adjustment factor is weighted by the aggregate pre-policy expenditure share of G within the expenditure categories which are mapped to a common sector S

$$\textbf{(7)}\ \ \mathbf{adj\_factor_{inc}}S(21,62,63) = \sum_{G} \frac{\pi_G}{\sum_{G \leftrightarrow S} \pi_G} * \ \mathbf{effect_{ela_{inc}}}G$$

2.3.1 Input variables

Variable	Description	Dimension	Source	Unit
$\pi_{D,G}$	Average budget share of decile D for expenditure category G	D x G	HH_data_with_elas.xlsx	Share
MS_rev_inc	Total revenue recycled into direct transfers or income tax cuts	S x 1	**TO BE CHANGED** (at the moment from revenue tab in Results_ISO.xlsx)	1000 US$ 2019
$ela\_income_{G,D}$	Average income elasticity of demand for expenditure category G in decile D	D x G	HH_data_with_elas.xlsx	Elasticity
$final\ demand_S$ (MS_q)	Final household demand for commodity S in country of interest (irrespective of origin)	S x 1	**TO BE CHANGED** (at the moment from revenue tab in Results_ISO.xlsx)	1000 US$ 2019
concordance	Concordance table between GLORIA sectors and expenditure categories	One row for each unique combination of S and G	GLORIA_CPAT_concordance.xlsx (from GTAPtoGLORIA.xlsx and CPAT_GTAP.xlsx)	
T	Targeted decile: Each expenditure decile equal or below T receives the same transfer	scalar	User defined	[1,10]

2.3.2 Output: (when calling HHdemand_adjustments_income_GLORIA with inputs)

Variable	Description	Dimension	Source	Unit
adj_factor_incS	Income adjustment factor of demand per GLORIA sector S given price changes : Multiplied with pre-policy demand to retrieve hh demand after increase in disposable	S x 1	HHdemand_adjustments_income_GLORIA	Factor

[6] S**ccl, fwd** : both mapped to 21 (forestry and logging) and **die, ethanol, gso, ker, lpg** mapped to 62,63 (Coke oven products , refined petroleum products

	income due to revenue recycling			

2.3.3 Equations and Functions: Documentation in pdf

Equation	Function	Location	Calls on
1)	**get_weighted_income_adj_factors**(country, HH_data, MS_q, MS_rev_inc, concordance, decile_target=10)	sector_adj_factors.py l. 200	calc_total_demand_g
2)	**get_weighted_income_adj_factors**(country, HH_data, MS_q, MS_rev_inc, concordance, decile_target=10)	sector_adj_factors.py l. 260-264	calc_total_demand_g
3)	**get_weighted_income_adj_factors**(country, HH_data, MS_q, MS_rev_inc, concordance, decile_target=10)	sector_adj_factors.py l. 237-249	calc_total_demand_g
4)	**get_weighted_income_adj_factors**(country, HH_data, MS_q, MS_rev_inc, concordance, decile_target=10)	sector_adj_factors.py l. 237-249	calc_total_demand_g
5)	**get_weighted_income_adj_factors**(country, HH_data, MS_q, MS_rev_inc, concordance, decile_target=10)	sector_adj_factors.py l. 260-274	calc_total_demand_g
6)	**HHdemand_adjustments_income_GLORIA**(country, HH_data, MS_q, MS_rev_inc, concordance, decile_target = 10)	sector_adj_factors.py l. 308	petroleum_coke_frs_shares, get_weighted_income_adj_factors
7)	**HHdemand_adjustments_income_GLORIA**(country, HH_data, MS_q, MS_rev_inc, concordance, decile_target = 10)	sector_adj_factors.py l. 310-337	petroleum_coke_frs_shares, get_weighted_income_adj_factors

3 Glossary

MINDSET: Model of Innovation in Dynamic Low-Carbon Structural Economic and Employment Transformations

GLORIA: Global Resource Input Output Assessment Database

CPAT: Carbon Pricing Assessment Tool