Introduction to GEM-Care: Simple CGE Model and Mini GEM-Care

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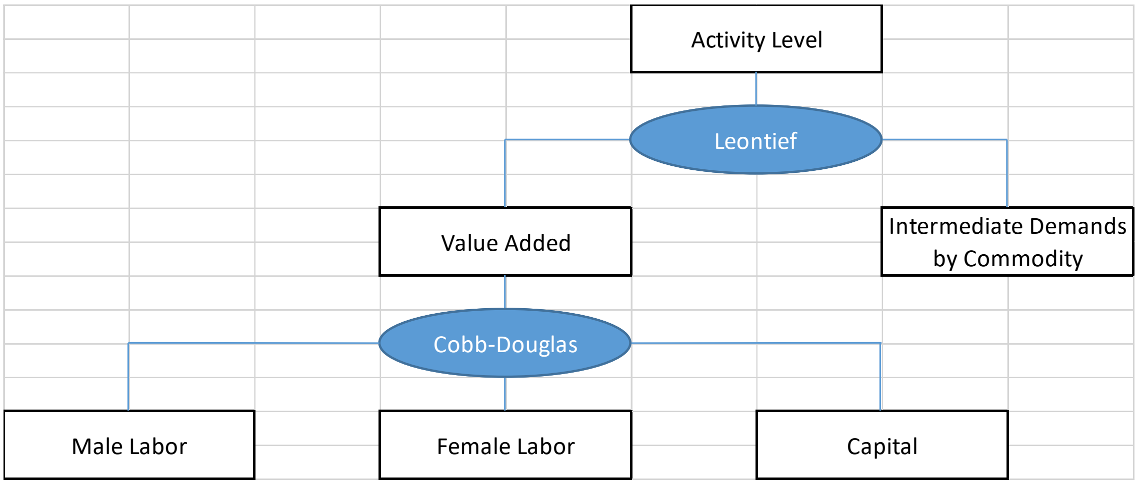
In this note, we present two Computable General Equilibrium (CGE) models. Firstly, we present a simple gendered CGE model that only covers the GDP economy. Secondly, we extend the first model to cover the non-GDP economy. Specifically, the second model – named Mini GEM-Care – extends the first model by also covering unpaid domestic and care work, and leisure. In a later session, we will see that GEM-Care extends Mini GEM-Care by, among other elements, considering an open economy, savings and investment, and care transfers among institutional sectors (i.e., inter-households care transfers and in-kind care transfers from the government to the households). To simplify, both models in this note single out a single representative household. In contrast, GEM-Care can handle multiple representative households.

1. Simple CGE Model (Gender in GDP Production)

Figure 1.1: production technology



Notation

Table 1.1 explains notational principles, designed to make it easy to understand the mathematical statement. Tables 1.2–1.5 define model sets, variables, Latin-letter parameters, Greek-letter parameters, respectively. In each of these tables, the items are arranged alphabetically.

Table 1.1: notational principles

Items	**Notation**	**Example**
Sets	Lower-case Latin letters as subscripts to variables and parameters	See the following rows:
Endogenous variables	Upper-case Latin letters (without a bar)*	QH_c
Exogenous variables**	Upper-case Latin letters with a bar*	$\overline{CPI}$
Parameters**	Lower-case Latin letters* or lower-case Greek letters (with or without superscripts)	$ica_{c,a}$; δ_a^k

*The names of Latin letter variables and parameters that refer to prices, quantities, and factor wages (rents) start with P, Q, and WF, respectively.

**The distinction between exogenous variables and parameters is that the latter always have exogenous values, whereas the former may be endogenous under alternative assumptions.

Table 1.2: sets

Name	Description
$a \in A$	activities
$c \in C$	commodities

Table 1.3: variables

Name	Description
CPI	consumer price index
EG	government spending
K_a	quantity demanded of capital factor from activity a
KS	supply of capital factor
LF_a	quantity demanded of female labor factor from activity a
LFS	supply of female labor factor
LM_a	quantity demanded of male labor factor from activity a
LMS	supply of male labor factor
PA_a	price of activity a
PQ_c	consumer price for commodity c
PVA_a	value-added price for activity a
PX_c	producer price for commodity c
Q_c	output level for commodity c
QA_a	level of activity a
QH_c	quantity consumed of commodity c by household
$QINT_{c,a}$	quantity of commodity c as intermediate input to activity a
R	rent for capital factor
$TYSCAL$	scaling factor for rate of direct tax
WF	wage for female labor factor
WM	wage for male labor factor
YG	government revenue
YH	income of household
YK	income of capital factor
YLF	income of female labor factor
YLM	income of male labor factor

Table 1.4: Latin letter parameters

Name	Description
$cwts_c$	weight of commodity c in the CPI
$ica_{c,a}$	intermediate input c per unit of activity a
qg_c	government demand for commodity c
ty	rate of income tax for household

ta_a	rate of tax on producer gross output value of activity a
tq_c	rate of sales tax for commodity c
$trnsfr_{gov}$	transfer from government to household

Table 1.5: Greek letter parameters

Name	Description
δ_a^k	share of value-added to capital factor in activity a
δ_a^{lm}	share of value-added to male labor factor in activity a
δ_a^{lf}	share of value-added to female labor factor in activity a
φ_a	efficiency parameter in the production function for activity a
$\theta_{a,c}$	yield of output c per unit of activity a
α_c	share of household consumption spending on commodity c

Equations

Derivation of Behavioral Equations

Behavioral Equations: Firms

The cost minimization problem for a firm that produces with a Cobb-Douglas production function can be written as

$$\min \bar{R} \cdot K_a + \overline{WM} \cdot LM_a + \overline{WF} \cdot LF_a$$

$$\text{s.t.}\, \overline{QA}_a = \varphi_a \cdot K_a^{\delta_a^k} \cdot LM_a^{\delta_a^{lm}} \cdot LF_a^{\delta_a^{lf}}$$

The firm chooses how much capital and male and female labor to demand taking as given the factor wages, the level of production, and the production technology.

Using the "Lagrangian" function, the problem of the firm may be rewritten as

$$\min \mathcal{L} = \bar{R} \cdot K_a + \overline{WM} \cdot LM_a + \overline{WF} \cdot LF_a + \lambda \cdot \left(\overline{QA}_a - \varphi_a \cdot K_a^{\delta_a^k} \cdot LM_a^{\delta_a^{lm}} \cdot LF_a^{\delta_a^{lf}}\right)$$

where λ is the Lagrangian multiplier. The First Order Conditions (FOCs) are

$$\frac{\partial \mathcal{L}}{\partial K_a} = \bar{R} - \lambda \cdot \varphi_a \cdot \delta_a^k \cdot K_a^{\delta_a^k - 1} \cdot LM_a^{\delta_a^{lm}} \cdot LF_a^{\delta_a^{lf}} = 0$$

$$\frac{\partial \mathcal{L}}{\partial LM_a} = \overline{WM} - \lambda \cdot \varphi_a \cdot K_a^{\delta_a^k} \cdot \delta_a^{lm} \cdot LM_a^{\delta_a^{lm} - 1} \cdot LF_a^{\delta_a^{lf}} = 0$$

$$\frac{\partial \mathcal{L}}{\partial LF_a} = \overline{WF} - \lambda \cdot \varphi_a \cdot K_a^{\delta_a^k} \cdot LM_a^{\delta_a^{lm}} \cdot \delta_a^{lf} \cdot LF_a^{\delta_a^{lf}-1} = 0$$

$$\frac{\partial \mathcal{L}}{\partial \lambda} = \overline{QA}_a - \varphi_a \cdot K_a^{\delta_a^k} \cdot LM_a^{\delta_a^{lm}} \cdot LF_a^{\delta_a^{lf}} = 0$$

Manipulating the first FOC,

$$\bar{R} = \frac{\lambda \cdot \delta_a^k \cdot \overline{QA}_a}{K_a}$$

$$\overline{WM} = \frac{\lambda \cdot \delta_a^{lm} \cdot \overline{QA}_a}{LM_a}$$

$$\overline{WF} = \frac{\lambda \cdot \delta_a^{lf} \cdot \overline{QA}_a}{LF_a}$$

Then, factor demands can be written as

$$K_a = \frac{PVA_a \cdot \delta_a^k \cdot \overline{QA}_a}{\bar{R}}$$

$$LM_a = \frac{PVA_a \cdot \delta_a^{lm} \cdot \overline{QA}_a}{\overline{WM}}$$

$$LF_a = \frac{PVA_a \cdot \delta_a^{lf} \cdot \overline{QA}_a}{\overline{WF}}$$

where λ (= marginal cost) was replaced by the activity value-added price PVA_a since profit-maximizing producers produce at the level where price for outputs equals marginal cost.

Behavioral Equations: Households

The utility maximization problem for a consumer with a Cobb-Douglas utility function can be written as

$$\max U = \prod_{c \in C} QH_c^{\alpha_c}$$

$$\text{s.t.}\, YH = \sum_{c \in C} \overline{PQ}_c \cdot QH_c$$

The consumer's problem is to choose the affordable bundle of goods that maximizes her utility, taking as given the prices of the goods, her income, and the utility function.

Using the Lagrangian function and applying it to a 2 goods case, the problem of the consumer can be rewritten as

$$\max \mathcal{L} = \prod_{c \in C} QH_c^{\alpha_c} + \lambda \cdot \left(YH \cdot (1 - ty) - \sum_{c \in C} \overline{PQ}_c \cdot QH_c \right)$$

For simplicity, let us assume that there are two commodities denoted as 1 and 2. Then, the FOCs are

$$\frac{\partial \mathcal{L}}{\partial QH_1} = \alpha_1 \cdot QH_1^{\alpha_1 - 1} \cdot QH_2^{\alpha_2} - \lambda \cdot \overline{P}_1 = 0$$

$$\frac{\partial \mathcal{L}}{\partial QH_2} = QH_1^{\alpha_1} \cdot \alpha_2 \cdot QH_2^{\alpha_2 - 1} - \lambda \cdot \overline{P}_2 = 0$$

$$\frac{\partial \mathcal{L}}{\partial \lambda =} \overline{YH} - \overline{P}_1 \cdot QH_1 - \overline{P}_2 \cdot QH_2 = 0$$

From the first two FOCs,

$$\frac{\alpha_1 \cdot QH_1^{\alpha_1 - 1} \cdot QH_2^{\alpha_2}}{QH_1^{\alpha_1} \cdot \alpha_2 \cdot QH_2^{\alpha_2 - 1}} = \frac{\overline{P}_1}{\overline{P}_2}$$

$$\frac{\alpha_1 \cdot QH_2}{\alpha_2 \cdot QH_1} = \frac{\overline{P}_1}{\overline{P}_2}$$

$$\overline{P}_2 \cdot QH_2 = \frac{\alpha_2}{\alpha_1} \cdot \overline{P}_1 \cdot QH_1$$

Using the above equation to substitute for $P_2 \cdot QH_2$ in the budget constraint,

$$\overline{YH} \cdot (1 - ty) = \overline{P_1} \cdot QH_1 + \frac{\alpha_2}{\alpha_1} \cdot \overline{P_1} \cdot QH_1$$

$$\overline{YH} \cdot (1 - ty) = \overline{P_1} \cdot QH_1 \cdot \left(1 + \frac{\alpha_2}{\alpha_1} \right)$$

$$\overline{YH} \cdot (1 - ty) = \overline{P_1} \cdot QH_1 \cdot \left(\frac{\alpha_1 + \alpha_2}{\alpha_1} \right)$$

Given this, the demand function for commodity 1 may be defined as follows, with the simplification based on the fact that $\alpha_1 + \alpha_2 = 1$, a condition that must hold in order for households spending and income to be equal: (Exercise: show this!)

$$QH_1 = \frac{\alpha_1 \cdot \overline{YH} \cdot (1 - ty)}{\overline{P_1}}$$

Similarly, the demand function for commodity 2 becomes:

$$QH_2 = \frac{\alpha_2 \cdot \overline{YH} \cdot (1 - ty)}{\overline{P_2}}$$

Table 1.6: production (activities and commodities)

PRD1	Cobb-Douglas production function $QA_a = \varphi_a \cdot K_a^{\delta_a^k} \cdot LM_a^{\delta_a^{lm}} \cdot LF_a^{\delta_a^{lf}}$	$a \in A$
PRD2	capital demand $K_a = \frac{\delta_a^k \cdot PVA_a \cdot QA_a}{R}$	$a \in A$
PRD3	male labor demand $LM_a = \frac{\delta_a^{lm} \cdot PVA_a \cdot QA_a}{WM}$	$a \in A$
PRD4	female labor demand $LF_a = \frac{\delta_a^{lm} \cdot PVA_a \cdot QA_a}{WF}$	$a \in A$
PRD5	intermediate input demand $QINT_{c,a} = ica_{c,a} \cdot QA_a$	$c \in C$ $a \in A$
PRD6	commodity production $Q_c = \sum_{a \in A} \theta_{a,c} \cdot QA_a$	$c \in C$
PRD7	activity price $PA_a = \sum_{c \in C} \theta_{a,c} \cdot PX_c$	$a \in A$
PRD8	demand price (including sales tax) $PQ_c = (1 + tq_c) \cdot PX_c$	$c \in C$
PRD9	value added price $PVA_a = PA_a \cdot (1 - ta_a) - \sum_{c \in C} PQ_c \cdot ica_{c,a}$	$a \in A$

Table 1.7: factor incomes and institutions

FAC1	income of capital factor $YK = \sum_{a \in A} R \cdot K_a$	
FAC2	income of male labor factor	

	$$YLM = \sum_{a \in A} WM \cdot LM_a$$	
FAC3	income of female labor factor $$YLF = \sum_{a \in a} WF \cdot LF_a$$	
HH1	household income $$YH = YK + YLM + YLF + trnsfr_{gov} \cdot \overline{CPI}$$	
HH2	household consumption demand function $$QH_c = \frac{\alpha_c \cdot YH \cdot (1 - ty \cdot TYSCAL)}{PQ_c}$$	$c \in C$
GOV1	government revenue $$YG = \sum_{a \in A} ta_a \cdot PA_a \cdot QA_a + \sum_{c \in C} tq \cdot PX_c \cdot Q_c + ty \cdot TYSCAL \cdot YH$$	
GOV2	government expenditures $$EG = \sum_{c \in C} PQ_c \cdot qg_c + trnsfr_{gov} \cdot \overline{CPI}$$	
GOV3	government balance $$YG = EG$$	

Table 1.8: equilibrium conditions and system constraints

EQ1	market equilibrium condition for capital factor $$\overline{KS} = \sum_{a \in A} K_a$$	
EQ2	market equilibrium condition for male labor factor $$\overline{LMS} = \sum_{a \in A} LM_a$$	
EQ3	market equilibrium condition for female labor factor $$\overline{LFS} = \sum_{a \in A} LF_a$$	
EQ4	market equilibrium condition for commodity c $$Q_c = \sum_{a \in A} QINT_{c,a} + QH_c + qg_c$$	$c \in C$
SYS1	consumer price index $$\overline{CPI} = \sum_{c \in c} PQ_c \cdot cwts_c$$	

NUMBER OF EQUATIONS: 6 x a + (c x a) + 4 x c + 11

NUMBER OF VARIABLES: 6 x a + (c x a) + 4 x c + 14 with 3 exogenous factor endowments

Social Accounting Matrix: An Example

Table 1.9a: example SAM I

	a-agr	a-nagr	a-cr-gdp	c-agr	c-nagr	c-cr-gdp	f-lab-m	f-lab-f	f-cap	hhd	gov	tax-act	tax-com	tax-dir	total
a-agr				11.1											11.1
a-nagr					162.7										162.7
a-cr-gdp						3.8									3.8
c-agr	0.7	5.8	0.0							4.7	0.0				11.1
c-nagr	4.6	74.5	1.0							78.7	13.0				171.8
c-cr-gdp	0.0	0.2	0.0							1.7	1.9				3.8
f-lab-m	3.0	23.2	0.8												27.0
f-lab-f	0.5	15.0	1.6												17.1
f-cap	2.4	41.3	0.4												44.1
hhd							27.0	17.1	44.1		4.0				92.2
gov												2.7	9.2	7.0	18.9
tax-act	-0.1	2.7	0.1												2.7
tax-com				0.1	9.1										9.2
tax-dir										7.0					7.0
total	11.1	162.7	3.8	11.1	171.8	3.8	27.0	17.1	44.1	92.2	18.9	2.7	9.2	7.0	

Table 1.9b: notation for the example SAM I

Account	**Descrption**
a-agr	activities - agriculture
a-nagr	activities - non-agriculture
a-cr-gdp	activities - reproductive/care GDP
c-agr	commodities - agriculture
c-nagr	commodities - non-agriculture
c-cr-gdp	commodities - reproductive/care GDP
f-lab-m	labor - male
f-lab-f	labor - female
f-cap	capital
hhd	institutions - households
gov	institutions - government
tax-act	tax - indirect - activities
tax-com	tax - indirect - commodities
tax-dir	tax - direct - income

Steps in Model Calibration

1. Prices and wages (PX, R, WM, WF; implicitly PA) are set at one. (Implication: the related commodity and factor quantities reflect what is traded at a price or wage of one.)
2. Given (1) and selected values of SAM cells, it is possible to define the base-year levels of all remaining variables (prices: PVA, PQ; quantities: QA, Q, K, LM, LFD, KS, LMS, LFS, QINT, QH; incomes: YK, YLM, YLF, YH, YG).
3. The share parameters (α, δ, θ) are defined as shares of cell payments in column totals (for sectors, factors, and households).
4. ϕ is defined once the other items in the value-added production function are defined.
5. When solved, the resulting model will replicate base-year data; the model solution can be used to define a SAM (which will be identical to the original SAM).

2. Mini GEM-Care

In Mini GEM-Care, we extend the simpler model by adding (a) substitution between male and female labor in GDP and non-GDP activities (i.e., two-level production function); (b) substitution between GDP and non-GDP commodities in household consumption (i.e., two-level utility function); and (c) adjusted tax base for income tax (i.e., tax base for income tax is income from GDP activities). Figure 2.1 summarizes the transmission channels that link household demand and production of non-GDP (care) services.

Figure 2.1: household demand and supply of non-GDP services

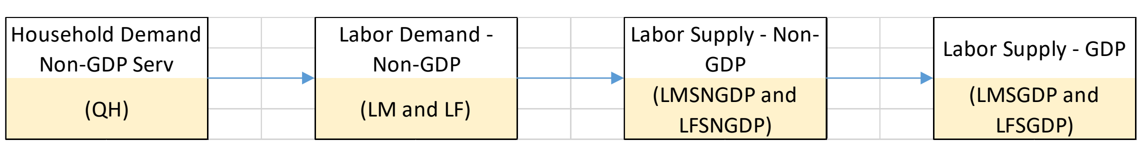


Figure 2.2: nested production technology GDP activities

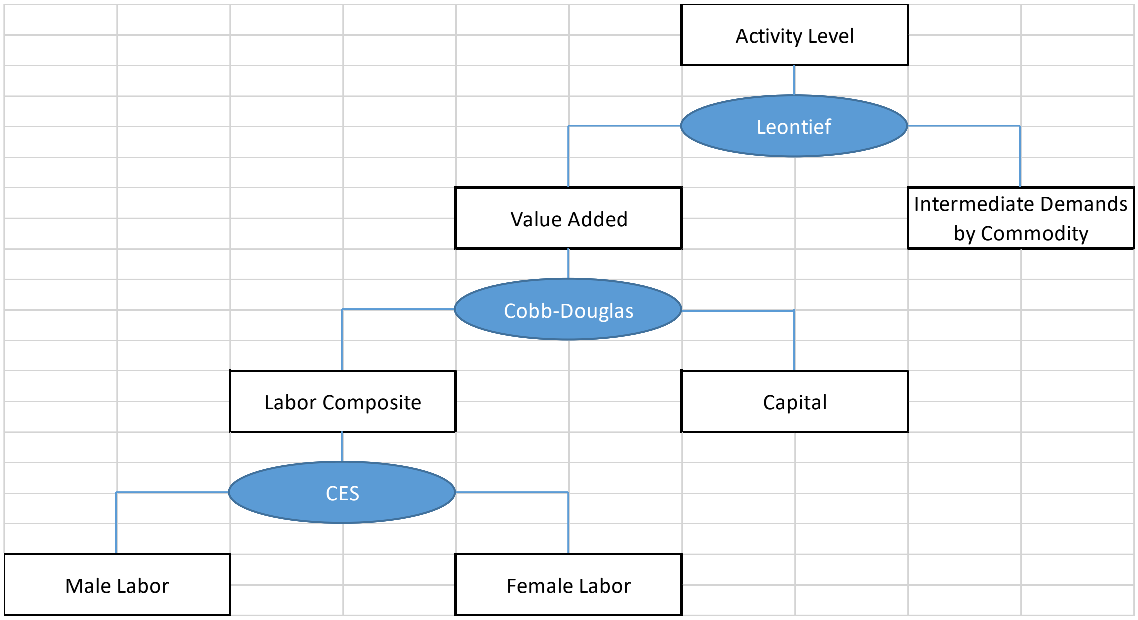


Figure 2.3: nested production technology non-GDP activities

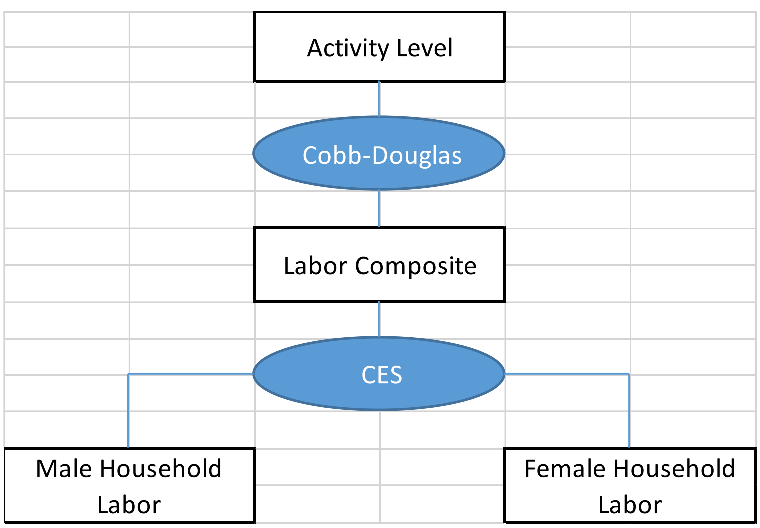
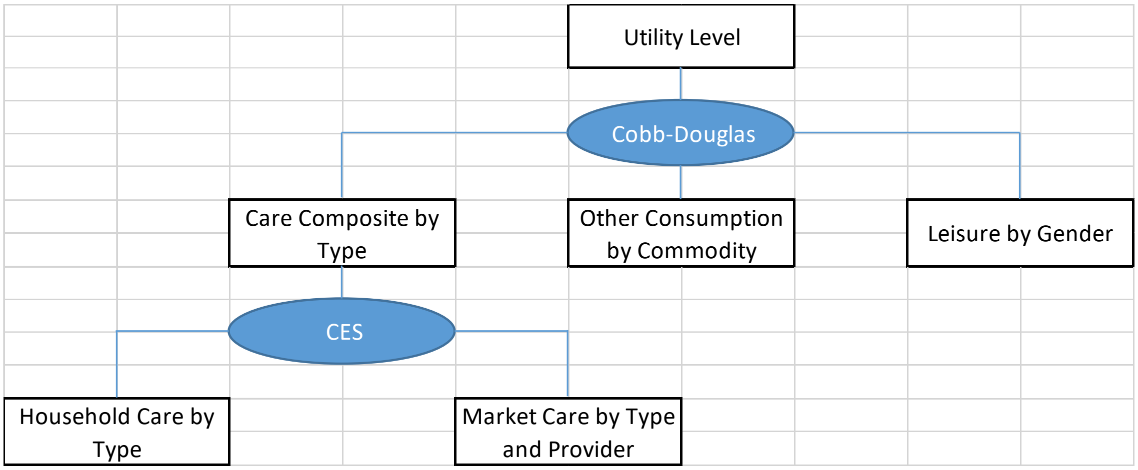


Figure 2.3: nested structure of household consumption



Notation

To save space, Tables 2.1-2.3 only show the new sets, variables, and Greek-letter parameters, respectively. Table 2.1 also include mappings between (a) representative households and non-GDP activities, and (b) commodities the bottom nest and commodities in top nest of utility function.

Table 2.1: sets

Name	**Description**
$a \in AGDP(\subset A)$	GDP activities
$a \in ANGDP(\subset A)$	Non-GDP activities (unpaid domestic and care work and leisure)
$c \in CGDP(\subset C)$	GDP commodities
$c \in CNGDP(\subset C)$	Non-GDP commodities (unpaid domestic and care work and leisure)
$c \in C1(\subset C)$	commodities at level 1 of utility function
$c \in C2(\subset C)$	commodities at level 2 of utility function
$c \in CSAM(\subset C)$	commodities in SAM
$c \in CSNAM(\subset C)$	commodities not in SAM
$(h,a)c \in MHANGDP(H, ANGDP)$	mapping between households and reproductive and leisure activities
$(c,c')c \in MC2C1(C2, C1)$	mapping between commodities in C2 and commodities in C1 (C2 is aggregated to C1)

Table 2.2: variables

Name	Description
$KSGDP$	supply of capital factor to GDP activities
L_a	quantity demanded of composite labor factor from activity a
$LFSGDP$	supply of female labor factor to GDP activities
$LFSNGDP$	supply of female labor factor to non-GDP activities
$LMSGDP$	supply of male labor factor to GDP activities
$LMSNGDP$	supply of male labor factor to non-GDP activities
$PQ_{c,d}$	price of commodity c for demander d, with d = a (activities), hhd (households), and gov (government)
W_a	wage for composite labor factor in activity a
$YKGDP$	income of capital factor from GDP activities
$YLFGDP$	income of female labor factor from GDP activities
$YLFNGDP$	income of female labor factor from non-GDP activities
$YLMGDP$	income of male labor factor from GDP activities
$YLMNGDP$	income of male labor factor from non-GDP activities

Table 2.3: Greek letter parameters

Name	Description
δ_a^k	share of value-added to capital factor in activity a
δ_a^l	share of value-added to composite labor factor in activity a
δ_a^{lm}	share of production function level 2 to male factor f in activity a
δ_a^{lf}	share of production function level 2 to female factor f in activity a
φ_a^2	efficiency parameter in the level 2 of production function for a
σ_a^2	elasticity of substitution between factors in the level 2 of production function for activity a
ρ_a^2	exponent in the level 2 of production function for activity a
δ_c^{qh}	distribution parameter household consumption of composite commodities
φ_{c1}^{qh}	scale parameter household consumption of composite commodities
σ_{c1}^{qh}	elasticity of substitution between household composite commodities
ρ_c^{qh}	exponent in household consumption of composite commodities

Equations

To simplify, we assume that non-GDP activities only use male and female labor. In practice, it is difficult to estimate the quantity of capital services that are used in the production of non-GDP services. In Tables 2.4-2.6, we use yellow to signal the equations that are new to this model or that are modified when compared to the simpler model in the previous section. In Mini GEM-Care, the composite labor factor (i.e., male and female labor composite) is not in SAM. Equations HH3 and HH4 (i.e., household consumption level 2) define the composite non-SAM commodities as CES functions of SAM commodities.

Table 2.4: production (activities and commodities)

PRD1	Cobb-Douglas production function $$QA_a = \varphi_a \cdot K_a^{\delta_a^k} \cdot L_a^{\delta_a^l}$$	$a \in A$
PRD2	capital demand $$K_a = \frac{\delta_a^k \cdot PVA_a \cdot QA_a}{R}$$	$a \in A$
PRD3	composite labor demand $$L_a = \frac{\delta_a^l \cdot PVA_a \cdot QA_a}{W_i}$$	$a \in A$
PRD4	CES production function for activity a (level 2) $$L_a = \varphi_a^2 \cdot \left(\delta_a^{lm} \cdot LM_a^{-\rho_a^2} + \delta_a^{lf} \cdot LF_a^{-\rho_a^2}\right)^{\frac{-1}{\rho_a^2}}$$	$a \in A$
PRD5	male labor demand $$LM_a = \left(\frac{W_a}{WM}\right)^{\sigma_a^2} \cdot (\delta_a^{lm})^{\sigma_a^2} \cdot (\varphi_a^2)^{\sigma_a^2-1} \cdot L_a$$	$a \in A$
PRD6	female labor demand $$LF_a = \left(\frac{W_a}{WF}\right)^{\sigma_a^2} \cdot \left(\delta_a^{lf}\right)^{\sigma_a^2} \cdot (\varphi_a^2)^{\sigma_a^2-1} \cdot L_a$$	$a \in A$
PRD7	intermediate input demand $$QINT_{c,a} = ica_{c,a} \cdot QA_a$$	$c \in C$ $a \in A$
PRD8	commodity production $$Q_c = \sum_{a \in A} \theta_{a,c} \cdot QA_a$$	$c \in C$
PRD9	activity price $$PA_a = \sum_{c \in C} \theta_{a,c} \cdot PX_c$$	$a \in A$
PRD10	demand price (including sales tax) $$PQ_{c,d} = (1 + tq_c) \cdot PX_c$$	$c \in C$ $d \in D$
PRD11	value added price $$PVA_a = PA_a \cdot (1 - ta_a) - \sum_{c \in C} PQ_{c,a} \cdot ica_{c,a}$$	$a \in A$

Table 2.5: factor incomes and institutions

FAC1	income of capital factor from GDP activities	

	$$YKGDP = \sum_{a \in AGDP} R \cdot K_a$$	
FAC2	income of male labor factor from GDP activities $$YLMGDP = \sum_{a \in AGDP} WM \cdot LM_a$$	
FAC3	income of female labor factor from GDP activities $$YLFGDP = \sum_{a \in AGDP} WF \cdot LF_a$$	
FAC4	Income of male labor factor from non-GDP activities $$YLMNGDP = \sum_{a \in ANGDP} WM \cdot LM_a$$	
FAC5	Income of female labor factor from non-GDP activities $$YLFNGDP = \sum_{a \in ANGDP} WF \cdot LF_a$$	
FAC6	supply of male labor factor to non-GDP activities $$LMSNGDP = \sum_{a \in ANGDP} LM_a$$	
FAC7	supply of female labor factor to non-GDP activities $$LFSNGDP = \sum_{a \in ANGDP} LF_a$$	
FAC8	supply of capital factor to GDP activities $$KSGDP = \overline{KS}$$	
FAC9	supply of male labor factor to GDP activities $$LMSGDP = \overline{LMS} - LMSNGDP$$	
FAC10	supply of female labor factor to GDP activities $$LFSGDP = \overline{LSF} - LFSNGDP$$	
HH1	household income $$YH = YKGDP + YLMGDP + YLFGDP + YLMNGDP + YLFNGDP + trnsfr_{gov} \cdot \overline{CPI}$$	
HH2	household consumption demand function $$QH_c = \frac{\alpha_c \cdot [YH - (YH - YLMNGDP - YLFNGDP) \cdot ty \cdot TYSCAL]}{PQ_{c,hhd}}$$	$c \in C$
HH3	household consumption demand aggregation to level 1 commodity from level 2 commodities $$QH_c = \varphi_c^{qh} \cdot \left(\sum_{c2 \in MC2C1(C2,C1)} \delta_{c2}^{qh} \cdot QH_{c2}^{-\rho_c^{qh}} \right)^{\frac{-1}{\rho_c^{qh}}}$$	$c \in C1 \cap c \in CNSAM$
HH4	household consumption demand function for level 2 commodities $$QH_c = \left(\frac{PQ_{c1,hhd}}{PQ_{c,hhd}} \right)^{\sigma_{c1}^{qh}} \cdot \left(\delta_c^{qh}\right)^{\sigma_{c1}^{qh}} \cdot \left(\varphi_{c1}^{qh}\right)^{\sigma_{c1}^{qh}-1} \cdot QH_{c1}$$	$c \in C2$ $c1 \in MC2C1(C2,C1)$
GOV1	government revenue	

	$YG = \sum_{a \in A} ta_a \cdot PA_a \cdot QA_a + \sum_{c \in C} tq \cdot PX_c \cdot Q_c + ty \cdot TYSCAL \cdot (YH - YLMNGDP - YLFNGDP)$	
GOV2	government expenditures $EG = \sum_{c \in C} PQ_{c,gov} \cdot qg_c + trnsfr_{gov} \cdot \overline{CPI}$	
GOV3	government balance $YG = EG$	

Table 2.6: equilibrium conditions and system constraints

EQ1	market equilibrium condition for capital factor $KSGDP = \sum_{a \in aGDP} K_a$	
EQ2	market equilibrium condition for male labor factor $LMSGDP = \sum_{a \in AGDP} LM_a$	
EQ3	market equilibrium condition for female labor factor $LFSGDP = \sum_{a \in AGDP} LF_a$	
EQ4	market equilibrium condition for commodity c $Q_c = \sum_{a \in A} QINT_{c,a} + QH_c + qg_c$	$c \in C$
SYS1	consumer price index $\overline{CPI} = \sum_{c \in CGDP} PQ_{c,hhd} \cdot cwts_c$	

In case we have multiple representative households, we need to establish a mapping between households and reproductive and leisure activities; this is done in the GAMS code of Mini GEM-Care.

Social Accounting Matrix: An Example

Table 2.7a: example SAM II

	a-agr	a-nagr	a-cr-gdp	a-cr-ngdp	a-lei-m	a-lei-f	c-agr	c-nagr	c-cr-gdp	c-cr-ngdp	c-lei-m	c-lei-f	f-lab-m	f-lab-f	f-cap	hhd	gov	tax-act	tax-com	tax-dir	total
a-agr							11.1														11.1
a-nagr								162.7													162.7
a-cr-gdp									3.8												3.8
a-cr-ngdp										20.2											20.2
a-lei-m											26.3										26.3
a-lei-f												25.2									25.2
c-agr	0.7	5.8	0.0													4.7	0.0				11.1
c-nagr	4.6	74.5	1.0													78.7	13.0				171.8
c-cr-gdp	0.0	0.2	0.0													1.7	1.9				3.8
c-cr-ngdp																20.2					20.2
c-lei-m																26.3					26.3
c-lei-f																25.2					25.2
f-lab-m	3.0	23.2	0.8	4.7	26.3																58.0
f-lab-f	0.5	15.0	1.6	15.5		25.2															57.7
f-cap	2.4	41.3	0.4																		44.1
hhd													58.0	57.7	44.1		4.0				163.8
gov																		2.7	9.2	7.0	18.9
tax-act	-0.1	2.7	0.1																		2.7
tax-com							0.1	9.1													9.2
tax-dir																7.0					7.0
total	11.1	162.7	3.8	20.2	26.3	25.2	11.1	171.8	3.8	20.2	26.3	25.2	58.0	57.7	44.1	163.8	18.9	2.7	9.2	7.0	

Table 2.7b: notation for the example SAM II

Account	Descrption
a-agr	activities - agriculture
a-nagr	activities - non-agriculture
a-cr-gdp	activities - reproductive/care GDP
a-cr-ngdp	activities - reproductive/care non-GDP
a-lei-m	activities - leisure - male
a-lei-f	activities - leisure - female
c-agr	commodities - agriculture
c-nagr	commodities - non-agriculture
c-cr-gdp	commodities - reproductive/care GDP
c-cr-ngdp	commodities - reproductive/care non-GDP
c-lei-m	commodities - leisure - male
c-lei-f	commodities - leisure - female
marg	trade and transport margins
f-lab-m	labor - male
f-lab-f	labor - female
f-cap	capital
hhd	institutions - households
gov	institutions - government
tax-act	tax - indirect - activities
tax-com	tax - indirect - commodities
tax-dir	tax - direct - income