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AMPLE-CGE model: User guide

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AMPLE-CGE Model: User Guide

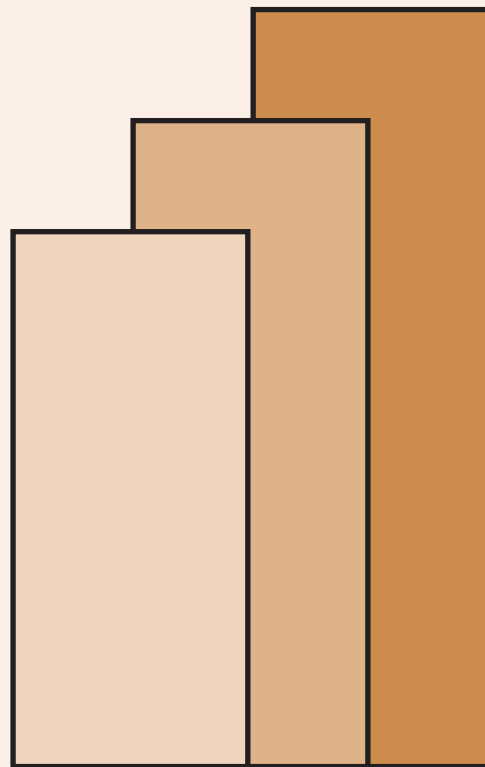
Ivory Myka R. Galang

DISCUSSION PAPER SERIES NO. 2017-41

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AMPLE CGE Model: User Guide

Ivory Myka Galang¹

Abstract

This User Guide is written to help prospective users learn how to navigate and run the AMPLE-CGE model. In the beginning, users will learn how to run the finished model and to display results in a software called Generalized Algebraic Modeling System or GAMS. Subsequently, the significance of and other important instructions concerning each part of the model code are explained. The construction and updating of the Philippine social accounting matrix (SAM) are discussed toward the end. Assuming that users are familiar with computable general equilibrium modelling and with the use of GAMS, they should be able to replicate the results of the AMPLE-CGE model.

Keywords: computable general equilibrium modelling, social accounting matrix

¹ Research Specialist, Philippine Institute for Development Studies. Any opinions, errors, and omissions of this paper are the author's sole responsibility.

AMPLE CGE Model: User Guide

The AMPLE – CGE model is an economywide extension of the Agricultural Model for Policy Evaluation (AMPLE), which is described in Briones (2010)². The agricultural sub-sectors of AMPLE-CGE are drawn from those of the original AMPLE. Apart from agricultural sub-sectors, sub-sectors from industry and services are also included. The model is described in more detail in Dr. Roehlano Briones’ discussion paper entitled “**Outlook for the Philippine Economy and Agro-industry to 2030: The Role of Productivity Growth.**”

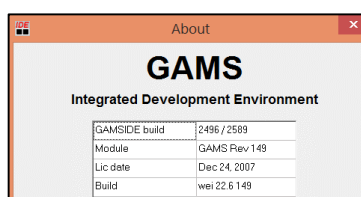
This User Guide aims to help prospective users learn how to navigate and run the AMPLE-CGE model. It is assumed that users have adequate knowledge of basic computable general equilibrium (CGE) modelling. Moreover, since the model is coded and solved in Generalized Algebraic Modeling System (GAMS)³, it is best for prospective users to familiarize themselves first with the software.

The model in this User Guide is discussed in reverse order. The first section is about running the finished model in GAMS and displaying the results. Then, Section II discusses the different parts of the model code and their significance, from declaring sets up to making projections. The last section explains how the social accounting matrix (SAM) was constructed and where data were sourced from.

Box 1. About GAMS

GAMS is a mathematical programming and optimization tool, which is used in modeling.⁴ It has a language compiler and a variety of solvers⁵. For this study, the preferred solver for nonlinear programming (NLP) is CONOPT3.

GAMS can easily be downloaded on the Internet, but users must secure a license file to run the program in their respective computers. The AMPLE-CGE model runs on **GAMS version 22.6**. The latest version available is **GAMS version 24.8.5**.



Below are some important coding rules in GAMS:

1. Statements must end with a semicolon “;”
2. Asterisk '*' can be used to indicate a non-language/ comment input.
3. GAMS is not case-sensitive

² Briones, R. 2010. Scenarios and Options for Productivity Growth in Philippine Agriculture: An Application of the Agricultural Multimarket Model for Policy Evaluation (AMPLE). PIDS Discussion Paper 2010-05. Makati City, Philippines: Philippine Institute for Development Studies.

³ See **Box 1**

⁴ <https://www.gams.com/products/introduction/>

⁵ <https://www.gams.com/24.8/docs/solvers/index.html>

I. How it works

A. Directories

All files necessary to construct and run the AMPLE-CGE model are found in **AMPLE CGE 2017** folder, and this can be downloaded from the following Google Drive link:
https://drive.google.com/open?id=0B_TCMluqwirBNkdDVHRyclEwLVU.

The **AMPLE CGE 2017** folder should be stored in Drive (C:) as all codes are programmed to source files from this particular drive.


There are four folders inside the AMPLE CGE 2017 folder (C:\AMPLE CGE 2017):

1. The **amplecge** folder contains data and codes to run the AMPLE-CGE model.
2. After running the AMPLE-CGE model, all results will be stored in the **results** folder.
3. The **sam** folder holds all files related to the updating of the SAM from year 2006 to 2013.
4. The 2006 input-output table and codes for sector aggregation are found in **io_ample aggregation** folder.

In running the codes in GAMS, it is important to check if the user is in the appropriate project directory, otherwise the user will encounter an error. A project directory allows the user to store and source files related to a project. For instance, **io_aggregation** is a project folder created solely for sector aggregation purposes. Separate project folders are created for SAM updating and for running the model.

B. Running the model

Open the file. To open the AMPLE-CGE model, go to C:\AMPLE CGE 2017\amplecge and then open the GAMS project file **amplecge2017.gpr**. From there, open **ample_cge_model.gms**, which is the main model file.

Run. In **ample_cge_model.gms** (C:\AMPLE CGE 2017\amplecge), click the run icon  or press F9. An active process window will be displayed. The user must find a line that reads OPTIMAL SOLUTION FOUND, which indicates that the model was successfully solved.

Display the results. In the **results** folder (C:\AMPLE CGE 2017\results), there are four macro-enabled Excel files that show projections for GDP, agriculture, industry, services, agro-industry, and wage growth under different scenarios.

1. Reference Scenario (ref.xlsx)

To display the results under this scenario, open **ref.xlsx**, then select **ref! sheet**. Click the top leftmost cell (**A1**) and then press Ctrl Q. All projections are automatically converted into percentages in **ref_pct! sheet**. Moreover, the

results of all scenarios are summarized in **tables!** and **charts! sheets**. These sheets are automatically updated after running the macro.

2. **Productive agriculture** (ag.xlsx)
To display the results under this scenario, open **ag.xlsx**, then select **ag! sheet**. Click the top leftmost cell (**A1**) and then press Ctrl W. All projections are automatically converted into percentages in **ag_pct** sheet.
3. **Climate Change Scenario** (cc.xlsx)
To display the results under this scenario, open **cc.xlsx** file, then select **cc! sheet**. Click the top leftmost cell (**A1**) and then press Ctrl E. All projections are automatically converted into percentages in **cc_pct! sheet**.
4. **Productive industry-services** (link.xlsx)
To display the results under this scenario, open **link.xlsx** file, then select **link! sheet**. Click the top leftmost cell (**A1**) and then press Ctrl R. All projections are automatically converted into percentages in **link_pct! sheet**.

II. Parts of the model

The GAMS program requires a certain coding organization. The following code sequence is suggested:

1. Set declarations
2. Variable and parameters declarations
3. Assignments
4. Equation declarations and definition
5. Model definition
6. Solve/Displays

Such coding sequence is implemented in **ample_cge_model.gms** (C:\AMPLE CGE 2017\amplecge). Each part of the model is discussed in this User Guide, but more detailed information about the model and its parts are available in the paper *Outlook for the Philippine Economy and Agro-industry to 2030: The Role of Productivity Growth*.

A. Sets

A separate GAMS file was created for set declarations. In **ample_cge_model** GAMS file, that external file is imported using the command: **\$include sets.gms** (See **Figure 1**). **Figure 2** shows how **set.gms** looks like.

Figure 1. Declaring sets in ample_cge_model GAMS file

```

fonttext
Last update: July 17, 2017
By Roshlano Eriones, a Senior Research Fellow at PIDS.
Assisted by Ivory Myka Galang, Research Specialist, PIDS.
Uses a SAM for 2013, derived from Input-Output Table 2006.
Sofftext

$include sets.gms

*****
***** VARIABLES AND PARAMETERS *****
*****

```

Figure 2. Sets GAMS file

```

*****SETS*****

Sets

samacct SAM accounts

A_Palay
A_Corn
A_Coconut
A_Sugarcane
A_Banana
A_Mango
A_Otfruit
A_Otcrop
A_Rootcrop
A_Ven

```

B. Variables and Parameters

Unlike the set declaration, variables and parameters (aka constants) declarations are written in the **ample_cge_model** GAMS file. Variable and parameter definitions are similarly found in this section of the model code (See **Figure 3**).

They are divided into blocks, namely, consumption, household, production, trade, other demand, other institutions, and other closure. For ease of reading, variables are written in uppercase letters, while parameters are in lowercase.

Figure 3. Variables and parameters section in ample_cge_model GAMS file

```

*****
***** VARIABLES AND PARAMETERS *****
*****

*****CONSUMPTION BLOCK*****

Variables
QC (G,H)      Household consumption per capita
QDC (G)      Total household consumption
PD (G)       Commodity price
XPD (H)      Household expenditure per capita
XPDmin (H)   Subsistence expenditure per capita

Parameters
;
qcmin (G,H)  Minimum household consumption per capita of G (subsistence)
beta (G,H)   Coefficient term in Linear Expenditure System
pop (H)      Population
lo (G,GG)    Matrix of technical coefficients

*****HOUSEHOLD BLOCK*****

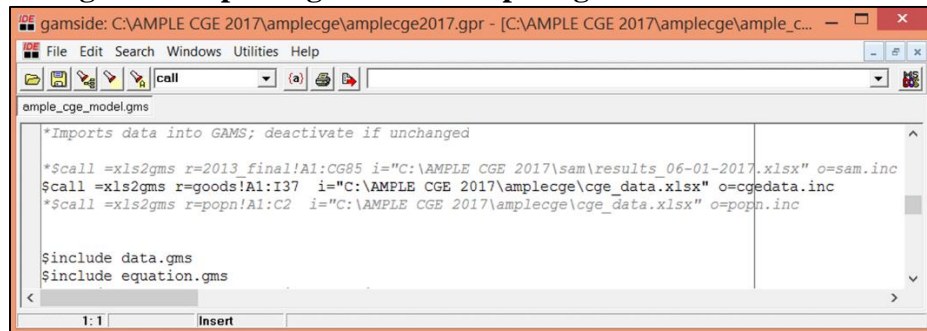
Variables
Y (H)       Total household income
KAFE (H)    Total household capital endowment
YD (H)      Household disposable income per capita

```

C. Assignment (Part 1)

Assignment means defining or associating values with sets, parameters, variables, or equations. In AMPLE-CGE model, assignment is done in several ways. One way is by importing data into the **ample_cge_model** GAMS file through the call statements enumerated below. These call statements convert Excel files into GAMS readable files (i.e. include files **[.inc]**). Should there be changes in any of these data files, the user must activate the corresponding call statement/s by deleting the preceding asterisk (*) (See **Figure 4**).

Figure 4. Importing data into ample_cge_model GAMS file



```
ample_cge_model.gms
*Imports data into GAMS; deactivate if unchanged
*$call =xls2gms r=2013_final!A1:CG85 i="C:\AMPLE CGE 2017\sam\results_06-01-2017.xlsx" o=sam.inc
$call =xls2gms r=goods!A1:I37 i="C:\AMPLE CGE 2017\amplecge\cge_data.xlsx" o=cgedata.inc
*$call =xls2gms r=popn!A1:C2 i="C:\AMPLE CGE 2017\amplecge\cge_data.xlsx" o=popn.inc

$include data.gms
$include equation.gms
```

1. **\$call =xls2gms r=2013_final!A1:CG85 i="C:\AMPLE CGE 2017\sam\results_06-01-2017.xlsx" o=sam.inc**

This line calls the Excel sheet **2013_final!** in **results_06-01-2017.xlsx**, which is the updated SAM for year 2013. All entries in the **2013_final!** sheet are in PHP millions. This Excel sheet is converted into an include file called **sam.inc**.

2. **\$call =xls2gms r=goods!A1:I37 i="C:\AMPLE CGE 2017\amplecge\cge_data.xlsx" o=cgedata.inc**

This line calls the Excel sheet **goods!** in **cge_data.xlsx**. The **goods!** sheet lists all commodities (which are denoted by “C_” in the variable name) and their corresponding elasticities. This Excel sheet is converted into an include file called **cge.inc**.

- a. **Epsilon_rur** and **Epsilon_urb** refer to expenditure elasticities of rural and urban households, respectively.
- b. **ownprice_rur** and **ownprice_urb** refer to own-price elasticities of rural and urban households, respectively.
- c. **sigmaD** refers to the elasticity of substitution in Armington composite.
- d. **sigmaS** refers to the elasticity of transformation in CET composite.
- e. **ntb** refers to non-tariff barrier effect on price.
- f. **sigmaVA** refers to the elasticity of substitution in CES Value Added (VA) function.

3. `$call =xls2gms r=popn!A1:C2 i="C:\AMPLE CGE 2017\amplecge\cge_data.xlsx" o=popn.inc`

This line calls the **popn! sheet** in **cge_data.xlsx**. The **popn! sheet** has information on 2013 population, which is disaggregated into rural and urban population using the rural-urban shares computed from the Family Income and Expenditure Survey (FIES) 2012. The population figures are in millions. This Excel sheet is converted into an include file called **popn.inc**.

After converting the Excel files into include (**.inc**) files, a separate GAMS file for assigning values is called using the statement: **\$include data.gms**. **Figure 5** shows how **data.gms** looks like. Those include files are then converted into GAMS tables. For instance, the first line in **data.gms** creates a table called **sam** with rows consisting of variables in **samacct** set and columns consisting of variables in **samacct2** set.

Declared parameters are assigned with initial values, which were either sourced from GAMS tables or inputted directly. For example, the parameter **sigmaVA(G)** obtains its values from the **cgedata** table with rows consisting of variables found in set **G** and column with name “**sigmaVA.**”

Initial values assigned for other parameters, such as capital stock, and price of labor in agriculture and in industry-services sectors, are inputted directly in the **data** GAMS file (See **Figure 6**).

Initial data for capital stock was based on the total capital formation (in real terms) of the Philippines from 1946 to 2013 obtained from Philippine Statistics Authority (PSA) National Accounts, which was then inflated by multiplying it with the GDP deflator. In the calculation of the capital stock, a depreciation rate of 0.07 was used. The same depreciation rate was applied to the projections of the model. Refer to **capital! Sheet** in **cge_data.xlsx** to see computation of the capital stock.

The data for the price of labor was based on the ratio of 2012 average daily basic pay in industry-services sectors and in agriculture, which were obtained from PSA’s Decent Work Statistics (DeWS)-Philippines (2016). Refer to **PLIS! Sheet** in **cge_data.xlsx** to see computation of the price of labor.

Figure 7 shows how another SAM data set called **samG** was created to move data from activities to commodities.

The minimum consumption parameter in linear expenditure system (LES) is calibrated in **les.gms** (See **Figure 8**).

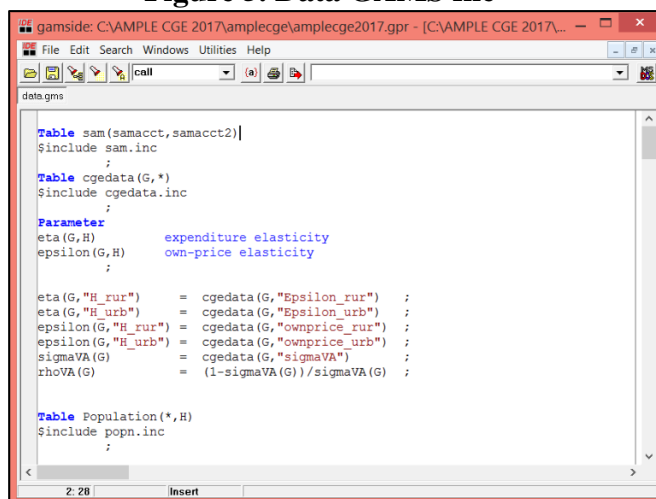
Box 2. About LES

LES refers to a system that expresses expenditures on individual commodities as linear functions of total expenditure and prices. The system works under the assumption that consumers first spend a certain amount of their income to obtain certain level of consumption for each commodity.⁶

It was originally developed by Richard Stone in 1954. In earlier studies, LES was applied for developed countries. Owing to a lack of long time-series data in developing countries, estimation of LES has been limited; oftentimes, a priori assumptions are made to be able to derive elasticity parameters.⁷

Parameter counterparts of already declared variables were created to store initial values. They are denoted by the number “0” attached to the original variable name (See **Figure 9**). For example, *QC0* is a counterpart of variable *QC*, which holds the assigned initial value.

Figure 5. Data GAMS file



```
data.gms
Table sam(samacct,samacct2)
$include sam.inc
;
Table cgedata(G,*)
$include cgedata.inc
;
Parameter
eta(G,H)          expenditure elasticity
epsilon(G,H)      own-price elasticity
;

eta(G,"H_rur")   = cgedata(G,"Epsilon_rur") ;
eta(G,"H_urb")   = cgedata(G,"Epsilon_urb") ;
epsilon(G,"H_rur") = cgedata(G,"ownprice_rur") ;
epsilon(G,"H_urb") = cgedata(G,"ownprice_urb") ;
sigmaVA(G)       = cgedata(G,"sigmaVA") ;
rhoVA(G)         = (1-sigmaVA(G))/sigmaVA(G) ;

Table Population(*,H)
$include popn.inc
;
```

⁶ <https://pdfs.semanticscholar.org/ef0e/399613adbb6c12b9a58e944adfd26eec8c47.pdf>

⁷ <http://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=1036&context=eri>

Figure 6. Household block in data GAMS file

```

C:\AMPLE CGE 2017\amplecge\data.gms
data.gms
*****HOUSEHOLD BLOCK*****
Parameters
Y0(H), KAPB0(H), YD0(H), SAV0, YTAX0, PKAP0, PLA0, PLIS0, XPD0(H), PUSD0;
;
*estimate from cgedata.xlsx capital!
*kapst = 24369586 ;
*kapst = 27286165 ;
kapst = 22006569 ;
*kapst = 17063900 ;
*see adbp.xls
PLA0 = 1 ;
PLIS0 = 2.26 ;
PUSD0 = 1 ;
Parameter kapstsm;

```

Figure 7. Building another sam data set in data GAMS file

```

C:\AMPLE CGE 2017\amplecge\data.gms
data.gms
Table Population(*,H)
$include popn.inc
;
pop(H) = population("Population",H);
*Build "another" sam to move data from "A_" to "C_"
Parameter
samG(samacct,G);
samG(samacct,"C_Palay ") = sam(samacct,"A_Palay ") ;
samG(samacct,"C_Corn") = sam(samacct,"A_Corn") ;
samG(samacct,"C_Coconut") = sam(samacct,"A_Coconut") ;
samG(samacct,"C_Sugarcane") = sam(samacct,"A_Sugarcane") ;
samG(samacct,"C_Banana") = sam(samacct,"A_Banana") ;
samG(samacct,"C_Mango") = sam(samacct,"A_Mango") ;

```

Figure 8. LES GAMS file

```

C:\AMPLE CGE 2017\amplecge\les.gms
les.gms
*For calibration of minimum consumption parameter in LES
Variables
QCmin0(G,H), XPDmin0(H), OBJ1(G,H), OBJ2 ;
*initial guess using elasticities supplied by user
QCmin0.L(G,H) = (epsilon(G,H)+1)*QC0(G,H)/(1-beta(G,H)) ;
XPDmin0.L(H) = sum(G,PD0(G)*QCmin0.L(G,H)) ;
Equations
EqLES(G,H), EqXPDmin0(H), EqOBJ1(G,H), EqOBJ2;
EqLES(G,H)..
QCmin0(G,H) =e= QC0(G,H) - (beta(G,H)/PD0(G))*XPD0(H)-XPDmin0(H) ;
EqXPDmin0(H)..
XPDmin0(H) =e= sum(G, QCmin0(G,H)*PD0(G)) ;
EqOBJ1(G,H)..
OBJ1(G,H) =e= QCmin0(G,H)-((epsilon(G,H)+1)*QC0(G,H))/(1-beta(G,H)) ;
EqOBJ2..
OBJ2 =e= sum((G,H), Sqr(OBJ1(G,H))) ;

```

Figure 9. Consumption block in data GAMS file

```

C:\AMPLE CGE 2017\amplecge\data.gms
data.gms
samG(samacct,"C_Finance") = sam(samacct,"A_Finance") ;
samG(samacct,"C_Otprivserv") = sam(samacct,"A_Otprivserv") ;
samG(samacct,"C_Pubserv") = sam(samacct,"A_Pubserv") ;
*****CONSUMPTION BLOCK*****
Parameters
QC0(G,H), QDC0(G), PD0(G), XPD0(H), XPDmin0(H), share(G,H) ;
PD0(G) = 1 ;
QC0(G,H) = (sam(G,H)/PD0(G))/pop(H) ;
QDC0(G) = sum(H, QC0(G,H)*pop(H)) ;
XPD0(H) = sum(G, PD0(G)*QC0(G,H)) ;
share(G,H) = PD0(G)*QC0(G,H)/XPD0(H) ;
beta(G,H) = share(G,H)*eta(G,H) ;
$include les.gms

```

D. Equations

A separate GAMS file was created for equation declarations and definitions, which can be imported by using the command **\$include equation.gms** in the **ample_cge_model** GAMS file (See **Figure 10**). All equation names start with “Eq”.

Figure 10. Equation GAMS file

```
*****CONSUMPTION BLOCK*****
Equations
EqQC(G,H), EqXPDmin(H), EqQDC(G)
;
EqQC(G,H) ..
PD(G)*QC(G,H) =e= PD(G)*qcmin(G,H) + beta(G,H)*(XPD(H)-XPDmin(H));
EqXPDmin(H) ..
XPDmin(H) =e= Sum(G, PD(G)*qcmin(G,H))
;
EqQDC(G) ..
QDC(G) =e= Sum(H, QC(G,H)*pop(H))
;
*****HOUSEHOLD BLOCK*****
Equation
EqY(H), EqKAP(H), EqYD(H), EqYTAX, EqSAV, EqXPD(H)
;
EqY(H) ..
Y(H) =e= PKAP*kape(H) + PLA*lambdaAg(H)*pop(H)*theta
+ PLIS*lambdaIS(H)*pop(H)
;
PKAP(H) ..
```

E. Assignment (Part 2)

After declaring and defining equations, initialization and bound-setting were done through the include file **prepare.gms**. Initialization means that previously declared variables (*variable name.L*) are equated to their counterparts (See **Figure 11**). For instance, **QC.L** will take the value of **QC0**.

Bound-setting, on the other hand, means that lower and upper bounds are defined for each of the variables, and they are denoted by **.lo** and **.up**, respectively. Lower bounds refer to minimum values that a variable can take. In this model, lower bounds are set to be very small, if not **0** (See **Figure 12**). In the case of upper bounds or maximum values, some were set as high as 1×10^{15} , while most variables were set at 100×10^{12} .

Figure 11. Initialization in prepare GAMS file

```

C:\AMPLE CGE 2017\amplecge\prepare.gms
prepare.gms
QC.L(G,H)      = QC0(G,H)      ;
QDC.L(G)       = QDC0(G)      ;
PD.L(G)        = PD0(G)       ;
XPD.L(H)       = XPD0(H)      ;
XPDmin.L(H)    = XPDmin0(H)   ;

Y.L(H)         = Y0(H)        ;
KAPE.L(H)      = KAPE0(H)     ;
YD.L(H)        = YD0(H)       ;
SAV.L          = SAV0         ;
YTAX.L         = YTAX0        ;
PKAP.L         = PKAP0        ;
PLA.L          = PLA0         ;

```

Figure 12. Bound-setting in prepare GAMS file

```

gamside: C:\AMPLE CGE 2017\amplecge\amplecge2017.gpr - [C:\AMPLE CGE 2017\...
optimal solution
ample_cge_model.gms | prepare.gms
*LOWER BOUND*
*Sontext
QC.LO(G,H)     = 0             ;
QDC.LO(G)      = 0             ;
PD.LO(G)       = 0.0000001    ;
XPD.LO(H)      = 0.0000001    ;
XPDmin.LO(H)   = 0.0000001    ;

Y.LO(H)        = 0.001        ;
KAPE.LO(H)     = 0.001        ;
YD.LO(H)       = 0.001        ;
SAV.LO         = 0.001        ;
YTAX.LO        = 0.001        ;
PKAP.LO        = 0.0000001    ;
PLA.LO         = 0.0000001    ;
PVA.LO(G)      = 0.0000001    ;
QVA.LO(G)      = 0.001        ;
KAP.LO(G)      = 0.001        ;
LA.LO(Ag)      = 0.001        ;
LIS.LO(IS)     = 0.001        ;

```

F. Checks

There are two types of checks implemented in this model, namely, check0 and check1.

1. check0

To implement this check in the **ample_cge_model.gms**, the user must activate the statement: **\$include check0.gms** and **\$exit** (See **Figure 13**). This replicates all equations at the baseline and checks if equality relationships hold true. **Figure 14** shows how check0 looks like.

After running check0, two windows will be displayed (See **Figure 15**). One is an active process window and the other is a resulting listing file. The active

process window displays all information about the process of running the model. Errors, if any, and completion status will be displayed. More importantly, the user must find a line that reads OPTIMAL SOLUTION FOUND, which indicates that the model was successfully solved.

In the resulting listing file (*.lst), all outputs are recorded, such as compilation output, solver report, and execution output. The user should click the expand button beside *Display* to see the resulting values of check variables (CH*). The values must be very small (e.g. 1×10^{-11}), if not zero, to say that equality relationships hold true. After the display, ensure that \$include check0.gms and \$exit statements are deactivated.

Figure 13. Activating check0 in ample_cge_model GAMS file

```

gmside: C:\AMPLE CGE 2017\amplecge\amplecge2017.gpr - [C:\AMPLE CGE 2017\...
File Edit Search Windows Utilities Help
ample_cge_model.gms
*Deactivate when done checking equations
*$include check0.gms
*$exit
$include prepare.gms

Model AMPLECGE
/EqQC, EqXPdmin, EqQDC,
EqY, EqKAPe, EqYD, EqYTAX, EqSAV, EqXPD,
EqQVAAG, EqQVAIS, EqKAP, EqLA, EqLIS, EqPVA, EqQS, EqVATAX,
EqPM, EqPD, EqQDH, EqQDF, EqQDFZ, EqPX, EqPS, EqQSH, EqQSF, EqQSFZ, EqMTAX,
EqQDINT, EqQDINV, EqQDGOV, EqQD,
EqSAVG, EqPISD, EqTSAV.
153: 9 Modified Insert

```

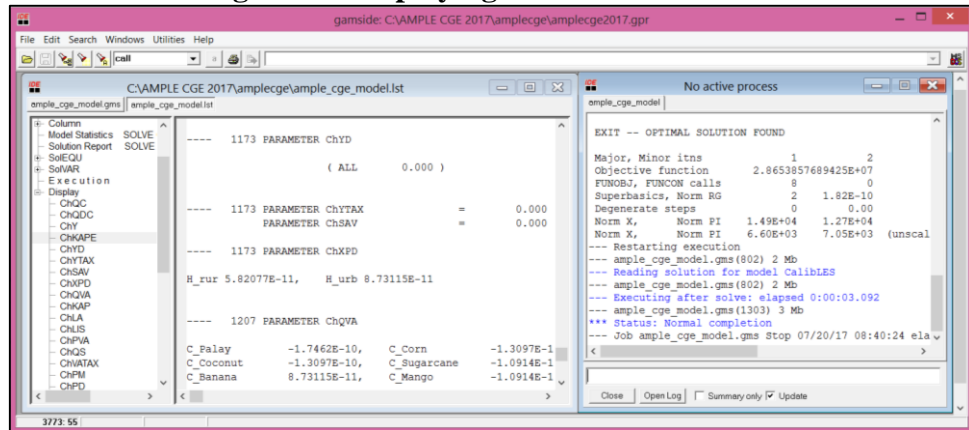
Figure 14. Check0 GAMS file

```

gmside: C:\AMPLE CGE 2017\amplecge\amplecge2017.gpr - [C:\AMPLE CGE 2017\...
File Edit Search Windows Utilities Help
check0.gms
*****CONSUMPTION BLOCK-----
Parameters
ChQC (G, H) , ChXPdmin, ChQDC (G) ;
ChQC (G, H) =
QC0 (G, H) - (qcmin (G, H) + ( beta (G, H) / PD0 (G) ) * ( XPD0 (H) - XPDmin0 (H) ) ) ;
ChXPdmin (H) =
XPdmin0 (H) - Sum (G, PD0 (G) * qcmin (G, H) ) ;
ChQDC (G) =
1: 1 Insert

```

Figure 15. Displaying check0 results



2. check1

To implement this check in the **ample_cge_model.gms**, the user must activate the statement: **\$include check1.gms** and **\$exit** (See **Figure 16**). After running the model at the baseline, Check1 shows how far the solution deviates from the baseline when values of certain exogenous variables are changed. Simply put, it calculates the difference (in percent) between the initial values and the solution (See **Figure 17**).

After running check1, same windows will appear as in check0. However, resulting values for check1 should be approximating zero if no shocks are introduced. If, however, shocks are introduced, (e.g. $pop(H) = 1.05 * pop(H)$, i.e. 5% population growth), then the display for check1 shows the changes in model variables, in percentage terms.

Figure 16. Activating check1 in ample_cge_model GAMS file

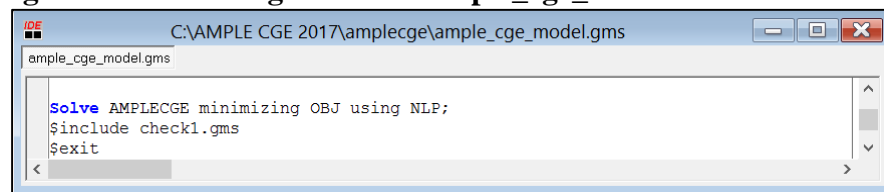
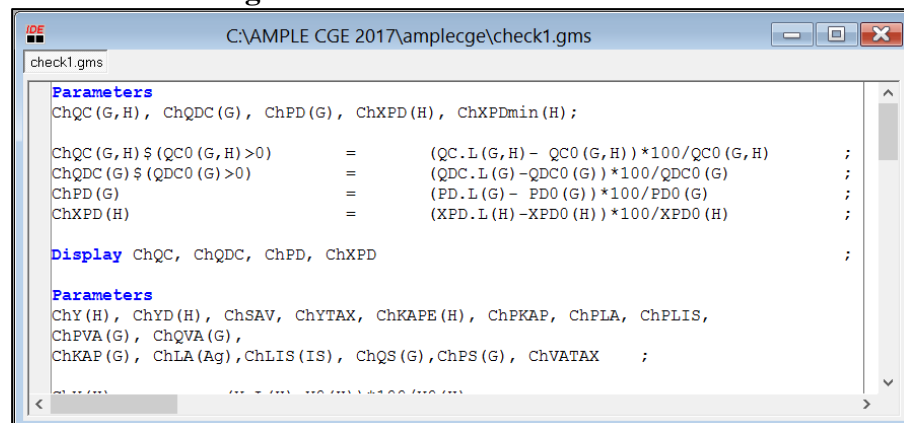


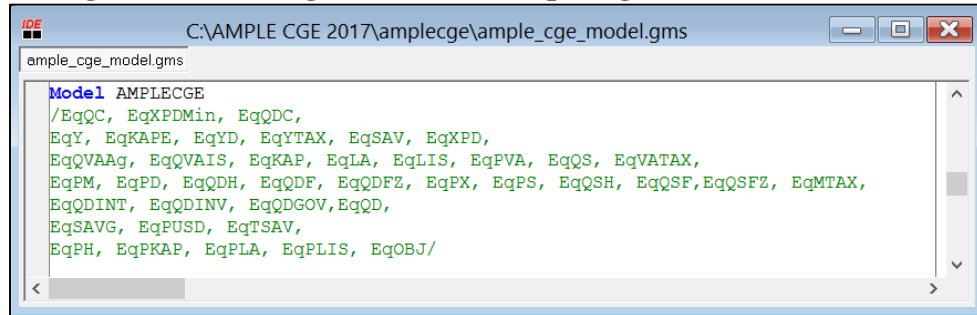
Figure 17. Check1 GAMS file



G. Model definitions

The model statement written in **ample_cge_model.gms** allows the user to group equations together and give them a label (See **Figure 18**). Note that all equations must have already been declared earlier.

Figure 18. Defining the model in ample_cge_model GAMS file



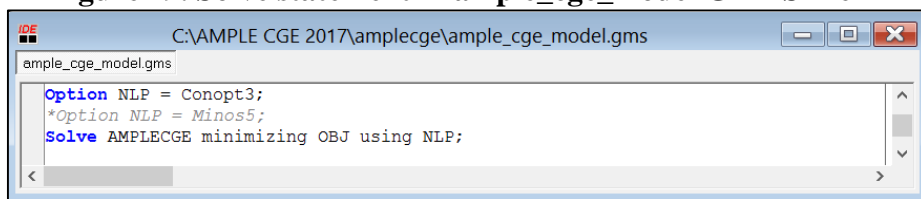
```
ample_cge_model.gms
Model AMPLECGE
/EqQC, EqXPdMin, EqQDC,
EqY, EqKAPE, EqYD, EqYTAX, EqSAV, EqXPD,
EqQVAAG, EqQVAIS, EqKAP, EqLA, EqLIS, EqPVA, EqQS, EqVATAX,
EqPM, EqPD, EqQDH, EqQDF, EqQDFZ, EqPX, EqPS, EqQSH, EqQSF, EqQSFZ, EqMTAX,
EqQDINT, EqQDINV, EqQDGOV, EqQD,
EqSAVG, EqPUSD, EqTSAV,
EqPH, EqPKAP, EqPLA, EqPLIS, EqOBJ/
```

H. Solve/display

The preferred solver for this model is Conopt3 (See **Figure 19**). Other options are Conopt, Minos, and Minos5. The solve statement specifies which model to solve and the model type. In this case, **AMPLECGE** is the model, while the model type is nonlinear programming (nlp).

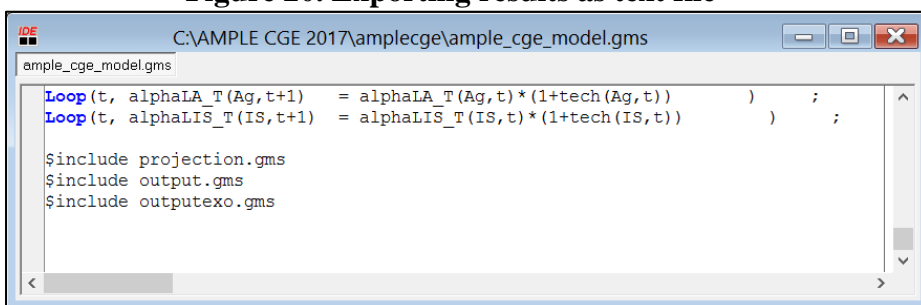
After solving the model, values for exogenous variables are exported to **outputexo.txt** (See **Figure 20** and **Figure 22**).

Figure 19. Solve statement in ample_cge_model GAMS file



```
ample_cge_model.gms
Option NLP = Conopt3;
*Option NLP = Minos5;
Solve AMPLECGE minimizing OBJ using NLP;
```

Figure 20. Exporting results as text file



```
ample_cge_model.gms
Loop(t, alphaLA_T(Ag,t+1) = alphaLA_T(Ag,t)*(1+tech(Ag,t)) ) ;
Loop(t, alphaLIS_T(IS,t+1) = alphaLIS_T(IS,t)*(1+tech(IS,t)) ) ;

$include projection.gms
$include output.gms
$include outputexo.gms
```


Figure 21. Outputexo GAMS file

```

FILE outputexo/ c:\AMPLE CGE 2017\results\outputexo.txt / ;
outputexo.pc = 6; outputexo.pw = 500; outputexo.nd = 4;
Put outputexo;

Put "Exogenous variables"; Put /;
Put "";
Loop(t, Put t.tl); Put /;
Put "Population"; Put /;
Loop(H,
Put H.tl;

```

I. Projections

Another set of parameters and variables were declared **ample_cge_model.gms** for projections (See **Figure 22**). “**T**” and index **t** are added to variable and parameter names to denote that they are time varying. For example, instead of simply pop_H , $pop_{H,t}$ is used for projections.

All shocks are introduced in year 2013. The effects of the shock shall be observed from year 2014 onwards.

All files starting with “**Exo_**” convert Excel tables of exogenous variables into GAMS include files (See **Figures Figure 23** and **Figure 24**). These include files are then used to create GAMS tables (See **Figure 25**). Exogenous variables refer to those variables that are not affected by (or independent from) other variables in the model. These are seeded with growth rate assumptions.

Projected growth rates from 2013 up to 2030 for various exogenous variables, which vary depending on the scenarios, are enumerated in sheets **ref_gr!**, **ag_gr!**, **cc_gr!**, and **link_gr!** of **cge_data.xlsx**. For example, in **ref_gr!** sheet, population growth rate of rural households are assumed to be 1.6% over the given period (See **Figure 26**). All exogenous variables used for projections are listed below:

1. Population (by household)
2. Income tax rate (by household)
3. Savings rate (by household)
4. Government transfers (by household)
5. Foreign transfers (by household)
6. Technical progress (by commodities) - *GAMS picks up the alpha equivalent of total factor productivity (TFP) growth rates.*
7. Business tax rate (by commodities)
8. Border price, imports (by commodities)
9. Border price, exports (by commodities)
10. tariff rate, imports (by commodities)

11. non-tariff barriers, imports (by commodities)
12. uva (by commodities)
13. Other exogenous variables are *gxp*, *ftrang*, *dep*, *theta*, and *savf*
14. sub (by commodities)

The variable “sub” refers to the subsidy per unit capital (in ad valorem terms). It is introduced in the capital equation, wherein the price of capital paid by the firm becomes $PKAP \cdot (1 - sub_G)$. Implications of capital subsidy in agriculture on sectoral growth and on overall growth could be tested. For example, a 10-percent increase in subsidy for rice could be applied in the model starting from 2018 onward.

Figure 22. Projections part in ample_cge_model GAMS file

```

*****PROJECTIONS*****
Parameters
pop_T(H,t),theta_T(t), kapst_T(t), dep_T(t),yt_T(H,t),s_T(H,t),
gtranh_T(H,t),ftranh_T(H,t),
alphaKAP_T(G,t),alphaLA_T(Ag,t), alphaLIS_T(IS,t),
vat_T(G,t),pwm_T(G,t),pwx_T(G,t),tar_T(G,t),ntb_T(G,t),
gxp_T(t),ftrang_T(t),uva_T(G,t),savf_T(t),
QC_T(G,H,t), QDC_T(G,t), PD_T(G,t), XPD_T(H,t),Y_T(H,t), KAPE_T(H,t),
YD_T(H,t), SAV_T(t),YTAX_T(t),PKAP_T(t),PLA_T(t), PLIS_T(t),
PVA_T(G,t),QVA_T(G,t),KAP_T(G,t),LA_T(Ag,t),LIS_T(IS,t),
QS_T(G,t),PS_T(G,t),VATAX_T(t),QD_T(G,t),QDH_T(G,t),QDF_T(G,t),PUSD_T(t),
PM_T(G,t),PH_T(G,t),PX_T(G,t),QSH_T(G,t),QSF_T(G,t),

```

Figure 23. Calling "Exo_" files in ample_cge_model.gms

```

$include exo_ref.gms
*$include exo_ag.gms
*$include exo_cc.gms
*$include exo_link.gms

```

Figure 24. Exo_ref GAMS file

```

*$call =xls2gms r=ref_gr!A2:S4 i="C:\AMPLE CGE 2017\amplecge\cge_data.xlsx" o=population.inc
*$call =xls2gms r=ref_gr!A7:S9 i="C:\AMPLE CGE 2017\amplecge\cge_data.xlsx" o=inctax.inc
*$call =xls2gms r=ref_gr!A12:S14 i="C:\AMPLE CGE 2017\amplecge\cge_data.xlsx" o=savingsr.inc
*$call =xls2gms r=ref_gr!A17:S19 i="C:\AMPLE CGE 2017\amplecge\cge_data.xlsx" o=govtran.inc
*$call =xls2gms r=ref_gr!A22:S24 i="C:\AMPLE CGE 2017\amplecge\cge_data.xlsx" o=fortran.inc
*$call =xls2gms r=ref_gr!A27:S63 i="C:\AMPLE CGE 2017\amplecge\cge_data.xlsx" o=tech.inc
*$call =xls2gms r=ref_gr!A66:S102 i="C:\AMPLE CGE 2017\amplecge\cge_data.xlsx" o=busstax.inc
*$call =xls2gms r=ref_gr!A105:S141 i="C:\AMPLE CGE 2017\amplecge\cge_data.xlsx" o=borderpm.inc
*$call =xls2gms r=ref_gr!A144:S180 i="C:\AMPLE CGE 2017\amplecge\cge_data.xlsx" o=borderpx.inc
*$call =xls2gms r=ref_gr!A183:S219 i="C:\AMPLE CGE 2017\amplecge\cge_data.xlsx" o=tariff.inc
*$call =xls2gms r=ref_gr!A222:S258 i="C:\AMPLE CGE 2017\amplecge\cge_data.xlsx" o=othbarrier.inc
*$call =xls2gms r=ref_gr!A261:S297 i="C:\AMPLE CGE 2017\amplecge\cge_data.xlsx" o=uvaproj.inc
*$call =xls2gms r=ref_gr!A300:S305 i="C:\AMPLE CGE 2017\amplecge\cge_data.xlsx" o=othexo.inc

FILE reference/ c:\AMPLE CGE 2017\results\reference.txt / ;
reference.pc = 6; reference.pw = 500; reference.nd = 4;

PUT reference;

```

Figure 25. Creating tables of assumed growth rates

```

C:\AMPLE CGE 2017\amplecge\ample_cge_model.gms
ample_cge_model.gms
$include exo_ref.gms
*$include exo_ag.gms
*$include exo_cc.gms
*$include exo_link.gms

Table popproj(H,t)
$include population.inc

Table inctax(H,t)
$include inctax.inc

Table busstax(G,t)
$include busstax.inc
;

Table savingsr(H,t)
$include savingsr.inc
;

```

Figure 26. Assumed growth rates in ref_gr! sheet

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Population																		
H_rur	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
H_urb	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
Income tax rate																		
H_rur																		
H_urb																		
Savings rate																		
H_rur																		
H_urb																		
Government transfers																		
H_rur	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
H_urb	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05

III. Constructing the SAM

In CGE modeling or other SAM-based researches, most recent economic data are needed to form a coherent baseline data set, but these data are usually obtained from different sources. Some examples of data sources are input-output tables, government accounts, and national accounts, among others. The usual method is to start working with an existing SAM, and then update it new data becomes available. Part of the work in constructing SAM is balancing it. There are numerous approaches to achieve a balanced SAM. (e.g. RAS method and Cross Entropy Method).⁸ This study implemented the widely used method, which is the RAS method (See Box 3).


This section discusses how a balanced SAM (2006) was constructed and how the entries were updated to year 2013.

⁸ http://www.un.org/en/development/desa/policy/mdg_workshops/eclac_training_mdgs/fofana_lemelin_cockburn_2005.pdf

A. Constructing SAM (2006)

The original PSA input-output table for 2006 has 240 sectors. These sectors need to be aggregated into just 36 sectors to match the number of sectors specified in AMPLE-CGE model.

Steps in aggregating the sectors:

1. Go to: **C:\AMPLE CGE 2017\io_ample aggregation.**
2. Open the project file **io_aggregation.gpr.**
3. Open the codes for aggregation **io_aggregation_ample2006.gms**⁹.
4. Check the filename used in the code. It should call the Excel file **IO_table2006_jan25.xlsx**¹⁰.
5. Refer to **coding_reference list.xlsx** for the list of variable names assigned to the sectors.
6. Check the number of sector classification.
 - a. Original I-O 2006 categories: 240 sectors.
 - b. AMPLE-CGE categories: 36 sectors.
7. Click run .
8. Find the text file **result06.txt**. Then open it with Excel.
9. Go to: **C:\AMPLE CGE 2017\sam.**
10. Open **SAM_2013.xlsx**.
11. Copy **result06! sheet** (of the text file) and paste it to SAM_2013's **output from gams! sheet**.
12. In **SAM_2013.xlsx**, there is also a sheet named **result06!**. It is just a reformatted version of **output from gams! sheet** with formula.

After aggregating the sectors, the matrix need to be balanced, which means that row totals must equal column totals.

Steps in balancing SAM 2006:

1. In **SAM_2013.xlsx**, go to **sam! sheet**.
2. Check the rows on taxes and tariff, Rows **81** and **82**, respectively.
3. Data entries on tariff (Row **82**) are tariff rates in 2000.¹¹
4. To check the taxes, run **io_aggregation_ample2006.gms** again.
5. Under the display portion, see **vadat0**.
6. Still in **SAM_2013.xlsx**, go to **sam (2006)! sheet**.
7. Read the comments or check the formula of highlighted cells for explanations.
8. Check if all entries in column **CJ** are zero (0) up to six (6) decimal places. Col. **CJ** is the difference between the row totals and column totals. To say that SAM 2006 is balanced, Col. **CJ** must be equal to 0.
9. If some entries in Col. **CJ** are not equal to 0, copy and paste them to Col. **CL**, while maintaining the row alignment. For example, if cell **CJ38** is not 0, copy and paste the value to **CL38**.
10. Col. **BY** (aka Households) automatically subtracts the residuals (Col. **CJ**) from its own values.
11. Save changes to **SAM_2013.xlsx**.

⁹ The original code for aggregation was from Corong, E. 2007. Aggregating Input-Output Table in GAMS.

¹⁰ This version reflects aggregated construction, durable goods, breeding, intellectual property, and change in inventories, which was collectively referred to as Investment (which is coded as SAVINV in GAMS).

¹¹ Corong, E. (n.d.) Tariff rates for Philippine CGE

B. Updating SAM (2013)

2013 values of some economic variables were gathered to form as basis for updating. Refer to **Table 1** and **Table 2** to see how the AMPLE-CGE accounts were matched with the Economic Accounts for commodities, and other macroeconomic variables, respectively. Open **psy chapter 3_14 econ accounts.xlsx** under C:\AMPLE CGE 2017\sam\updating_data to access the data. The sources for macroeconomic variables are also found in **Table 2**.

Actual sectoral shares in GDP were maintained in updating the SAM. This means that the actual share of agriculture sector in GDP in 2013 is the same as the one reflected in the AMPLE-CGE data set (i.e. SAM 2013).

Steps in computing the growth rates from 2006 to 2013:

1. In **SAM_2013.xlsx**, go to **data for updating! sheet**.
2. Fill in Col. **D** with **2013 Current Prices** from Chapter 3 Economic Accounts of the Philippine Statistical Yearbook (2014).
3. Values under Col. **H** (2006) come from the I-O table.
4. Col. **F** automatically computes the growth rates between 2006 and 2013.
5. After completing the growth rates, most cells in **sam_gams! sheet** are automatically updated, except for cells **CF78 (ftranh)** and **CF79 (ftrang)**.
6. Save changes to **SAM_2013.xlsx**.

Obtaining preliminary updated SAM

1. Go to C:\AMPLE CGE 2017\sam.
2. Open the project file **sambal.gpr**.
3. Find **NLP_new.gms** under C:\AMPLE CGE 2017\sam.
4. Activate the call statement.
5. Check if the file name and array are correct, then run the code.
6. Find the text file **results_nlp.txt**. Then open it with Excel.

Table 1. Economic accounts used for updating

AMPLE-CGE accounts	Economic Accounts (2013)
Palay	Palay
Corn	Corn
Coconut	Coconut including copra
Sugarcane	Sugarcane
Banana	Banana
Mango	Mango
Otfruit	Pineapple
Otcrop	88.33% of Sum(rubber, other crops, and coffee)
Rootcrop	Cassava
Vegetables	11.67% of Sum(rubber, other crops, and coffee)
Hog	82.26% of Livestock
Livestock	17.74% of Livestock

Poultry	Poultry
Agserv	Agricultural activities and services
Forestry	Forestry
Capfish	38.33% of Fisheries
Aquacult	61.67% of Fisheries
Mining	Mining
Rice	Food manufactures
Meat	Food manufactures
Procfish	Food manufactures
Sugar	Food manufactures
Otfoodmanuf	Food manufactures
Beverage	Beverage industries
Pestfert	Other manufactures (Tobacco manufactures, Textile manufactures, Wearing apparel, Footwear and leather and leather products, Wood, bamboo, cane and rattan articles, Paper and paper products, and Publishing and printing)
Otagbased	Other manufactures (Tobacco manufactures, Textile manufactures, Wearing apparel, Footwear and leather and leather products, Wood, bamboo, cane and rattan articles, Paper and paper products, and Publishing and printing)
Feeds	Other manufactures (Tobacco manufactures, Textile manufactures, Wearing apparel, Footwear and leather and leather products, Wood, bamboo, cane and rattan articles, Paper and paper products, and Publishing and printing)
Otmanuf	Petroleum and other fuel products, Chemical & chemical products, Rubber and plastic products, Non-metallic mineral products, Basic metal industries, Fabricated metal products, Machinery and equipment except electrical, Office, accounting and computing machinery, Electrical machinery and apparatus, Radio, television and communication equipment and apparatus, Transport equipment, Furniture and fixtures, and Miscellaneous manufactures
Otagmach	Petroleum and other fuel products, Chemical & chemical products, Rubber and plastic products, Non-metallic mineral products, Basic metal industries, Fabricated metal products, Machinery and equipment except electrical, Office, accounting and computing machinery, Electrical machinery and apparatus, Radio, television and communication equipment and apparatus, Transport equipment, Furniture and fixtures, and Miscellaneous manufactures
Otindustry	Construction, and Electricity, gas, and water supply
Transport	Land, water, air transport
Storage	Storage and services
WRtrade	Wholesale trade, and Retail trade

Finance	Banking institutions, non-bank financial intermediation, insurance, activities auxiliary to financial intermediation
Otprive	Communication, maintenance and repair of motor vehicles etc, real estate, other services (educ, health and social work, hotel, sewage, recreational act., and other service activities)
Publicserv	Public administration, defense, compulsory social services

Table 2. Other economic accounts used for updating SAM

AMPLE-GAMS variables	Economic Accounts	Sources
Total savings (TSAV)	Capital formation	PSY 2014
Government expenditure (GXPD)	Government consumption	PSY 2014
Consumption	Household consumption	PSY 2014
Indirect tax (BTAX)	BIR tax revenues: Excise Tax, Sales Taxes & Licenses, and Other Domestic Taxes	Bureau of the Treasury, Revenue
Tariff revenue	Bureau of Customs	Bureau of the Treasury, Revenue
Income tax (YTAX)	Net Income & Profits, Other Offices, Non-tax Revenues, and Grants	Bureau of the Treasury, Revenue
Government savings (GSAV)	Infrastructure Outlays	BESF 2015
Foreign transfers to households (FTRANH)	Sum of Compensation of Employees from the Rest of the World (ROW), Property & entrepreneurial income from ROW, Current Transfers from ROW to Households and Other Institutional Sectors less the sum of Property & entrepreneurial income to ROW, Current Transfers to ROW from Households and Other Institutional Sectors	Consolidated Accounts
Foreign transfers to government (FTRANG)	Current Transfers from ROW to General Government less Current transfers to ROW from General Government	Consolidated Accounts

After updating the SAM, the matrix becomes unbalanced so the following steps are necessary to achieve balance:

Steps in balancing SAM 2013:

1. Go to **C:\AMPLE CGE 2017\sam**.
2. Open **results_06-01-2017.xlsx**.
3. Find **results!** sheet in **results nlp.xlsx**.
4. Copy **results_nlp** and paste it to **results!** sheet.
5. To check the adjustments, see highlighted cells in **results (2)!** sheet.
 - i. Residuals (Col. **CM**) are transposed to row **88**.
 - ii. These (transposed) residuals are subtracted from CFC (row **75**).
6. One more adjustment is done to equalize the values to 2013 GDP. See **results (3)!** sheet.

Box 3. About RAS

RAS is a balancing technique mainly used when the aim is to incorporate new data (on the matrix row and column sums) into an existing matrix. It generates a new $n \times n$ matrix A_1 from an existing matrix A_0 , by applying row and column multipliers to achieve the new row and column totals. The main problem is to find a set of row and column multipliers, which can be solved by an optimization approach, using a GAMS application.¹²

C. Household disaggregation (Urban vs. Rural)

Households were split into rural and urban households using the shares obtained from FIES 2012. Refer to **Annex** for the documentation of FIES variables used to disaggregate the expenditure shares of rural and urban households.

Note that SavInv is the aggregated value of Construction, Durable equipment, Breeding stocks and orchards, Intellectual property, and Change inventory in Capital Formation, but they are weighted based on their shares in 2013 National Accounts.

The rural-urban household shares are found in **HH_shares!** sheet of **results_06-01-2017.xlsx**.

D. Labor disaggregation (Agriculture vs. Industry-Services)

Labor was split into Agriculture and Industry-Services based on the type of activity. Activities from A_Palay to A_Aquacult are considered as agricultural activities, while activities from A_Mining to A_PubServ are considered as Industry-Services activities.

¹² http://www.un.org/en/development/desa/policy/mdg_workshops/eclac_training_mdgs/fofana_lemelin_cockburn_2005.pdf

To further disaggregate labor, shares of rural and urban households per type of labor were again obtained from FIES 2012. The agriculture-industry-services labor shares are found in **ag_shares! sheet** of **results_06-01-2017.xlsx**.

One last round of balancing adjustments was made in **2013_final! sheet** of **results_06-01-2017.xlsx**. Click on the highlighted cells to see the changes.

IV. References

- Briones, R., 2017. Outlook for the Philippine Economy and Agro-industry to 2030: The Role of Productivity Growth. Discussion Paper Series No. 2017-30. Quezon City: PIDS.
- _____. 2010. Scenarios and Options for Productivity Growth in Philippine Agriculture: An Application of the Agricultural Multimarket Model for Policy Evaluation (AMPLE). Discussion Paper Series No. 2010-05. Makati City: PIDS. <https://dirp4.pids.gov.ph/ris/dps/pidsdps1005.pdf>.
- Corong, E. 2007. Aggregating Input-Output Table in GAMS.
- _____. (n.d.) Tariff rates for Philippine CGE.
- Philippine Statistics Authority. 2016. Decent Work Statistics (DeWS)-Philippines. <http://dews.psa.gov.ph/Resources/Summary/Decent%20Work%20Summary%20Tables.pdf> (accessed on July 15, 2017).

Annex: List of FIES variables used to disaggregate households

	AMPLE-CGE categories	FIES 2012 variables
Agriculture	1. Paddy rice	same as rice
	2. Corn	tcorn total corn expenses
	3. Coconut	tcoconut fruit (nuts-coconut) expenses
	4. Sugarcane	tsugar sugar expenses
	5. Banana	tfreshbanana Fruit (fresh-banana) expenses
	6. Mango	tfreshmango Fruit (fresh-mango) expenses
	7. Other fruit	tfreshpapaya fruit(fresh-papaya) expenses
		gfreshpapaya fruit(fresh - papaya) received as gifts
	8. Rootcrop	tvassava vegetables (potatoes and tubers- cassava) Expenditure
		tvcamote vegetables (potatoes and tubers- camote) Expenditure
	9. Other crop	ttobacco tobacco expenditure
		tcocoa coffee, cocoa, and tea (cocoa) expenses
	10. Vegetables	tveg Vegetables expenses – tvassava – tvcamote
	11. Swine	100% rural
	12. Other livestock	100% rural
	13. Poultry	100% rural
	14. Agricultural activities and services	eacfgexp crop farming and gardening expenses
ealprexp livestock and poultry raising expenses		
eafisexp fishing expenses		
15. Forestry	eaforexp forestry and hunting expenses	
16. Capture fishery	tfmilkfish fish(fresh- milkfish) expenses	
	tfgalngong fish(fresh- galunggong) expenses	
	tseafood fish (seafood) expenses	
17. Aquaculture	tftilapia fish(fresh-tilapia) expenses	
Industry	18. Mining	eamngexp mining and quarrying expenses
	19. Rice and corn milling	trice total rice expenses
	20. Meat production	tmeatfrozen meat (frozen) expenses

	tmdried	meat (dried) expenses
	tmpreserve	meat (preserved) expenses
21. Processed fish	tdfsh	fish (dried/smoked) expenses
	tpcfsi	fish (preserved) expenses
22. Sugar	tsugar	sugar expenses
23. Other food manufacturing	tmpreserve	meat (preserved) expenses
	tdfruit	fruit (dried) expenses
	tpresfruit	fruit (preserved) expenses
	tvegpreserve	vegetables (vegetable preserve) expenses
	tmraw	milk (raw) expenses
	tcondvap	milk (condensed, evaporated, or powdered) expenses
	tdessert	milk (dessert) expenses
	tmbeverage	milk (beverage) expenses
	tmsoya	milk (soya) expenses
	tmcheese	milk (cheese and curd) expenses
	toil	oils and fats expenses
	tice	ice cream, sorbet and edible ice expenses
tjamsmar	jams and marmalade expenses	
tfoodnec	food not elsewhere classified expenditure	
24. Beverage manufacturing	tnonalcohol	non-alcoholic beverages expenditure
	talcohol	alcoholic beverages expenditure
25. Pesticide and fertilizer	100% rural	
26. Other agri-based manufacturing	100% rural	
27. Feeds	100% rural	
28. Other manufacturing	eamfgexp	manufacturing expenses
	tclothfootwear	clothing, footwear, and other wear expenses
	tfurnishing	non-durable furnishings expenses
	tmiscperelectric	miscellaneous goods and services (personal care - electric appliance) expenses
	tmiscperother	miscellaneous goods and services (personal care - other appliance) expenses

		tmiscpereffects	miscellaneous goods and services (personal effects) expenses
	29. Manufacture of agricultural machinery	100% rural	
	30. Other industry	eaconexp	construction expenses
Services	31. Transport service	eatcsexp ttransport	transportation, storage and comcn services expenses transportation exp
	32. Storage service	eatcsexp	transportation, storage and comcn services expenses
	33. Trade service	eatrdexp	wholesale and retail trade expenses
	34. Finance	tmiscinsurance tmiscfinancial	miscellaneous goods and services (insurance) expenditure miscellaneous goods and services (financial services) expenditure
	35. Other private service	thousingwater trestaurant thealth tmiscpershair tmiscotherserve tcommunication trecreation	housing and water expenditure restaurant and hotels expenditure medical care expenditure miscellaneous goods and services (personal care - hairdressing salons) expenditure miscellaneous goods and services (other services) expenditure communication expenditure recreation expenditure
	36. Public service	teducation tmiscsocprot	education expenditure miscellaneous goods and services (social protection) expenses
		Households	
	SI-Construction	eaconexp	construction expenses
	SI-Durable equipment	tfurnishing	non-durable furnishings expenses
		tmiscperelectric	miscellaneous goods and services (personal care - electric appliance) expenses
		tmiscperother	miscellaneous goods and services (personal care - other appliance) expenses
	SI-Breeding stocks and orchards	100% rural	
	SI-Intellectual property	Same share as fixed capital	
	SI-Change inventory	Same share as fixed capital	