DECEMBER 2018

DISCUSSION PAPER SERIES NO. 2018-51

Scenarios for the Philippine Agri-Food System with and without Tariffication: Application of a CGE model with Endogenous Area Allocation

Roehlano M. Briones

CONTACT US:

RESEARCH INFORMATION DEPARTMENT
Philippine Institute for Development Studies

18th Floor, Three Cyberpod Centris - North Tower
EDSA corner Quezon Avenue, Quezon City, Philippines

publications@mail.pids.gov.ph
(+632) 372-1291/(+632) 372-1292

https://www.pids.gov.ph

Scenarios for the Philippine Agri-Food System with and without Tariffication: Application of a CGE model with Endogenous Area Allocation

Roehlano M. Briones

PHILIPPINE INSTITUTE FOR DEVELOPMENT STUDIES

December 2018

Abstract

This paper presents an application of a CGE model to analyze scenarios covering the SDG period at the level of the Philippine economy and for its agri-food sectors. Unlike previous CGE models, the analysis incorporates endogenous area allocation under an aggregate land constraint. The area allocation model is based on constant elasticity of transformation of area harvested in an outer nest between perennial and temporary crops, and an inner nest among the types of perennials and among the types of temporary crops.

The baseline scenario finds that growth patterns prevailing since the 2010s can be sustained within the SDG period assuming productivity trends industry and service sectors continue. Unfortunately, the scenario also implies that the mediocre growth performance of agriculture will likewise be sustained into the foreseeable future. Growth proceeds at a moderate pace for most of the agri-food sectors, with the significant exception of banana, which is expected to contract. Similarly, the major crops are all projected to experience a growth in yield and minor change in area harvested, except for banana where deterioration in both indicators is marked.

The usefulness of CGE model is demonstrated by applying it to a policy experiment, corresponding to one of the largest reform initiatives in Philippine agriculture, namely the tariffication of the rice import quota. Tariffication is disadvantageous to the palay sector across various measures, namely area harvested, yield, and production. Even agriculture as a whole is adversely affected, experiencing a further growth slowdown. Nonetheless, overall growth of GDP as well as household per capita expenditure rises with greater openness to rice imports. Consistent with expectation, imports are larger with tariffication, leading to more affordable consumer price of rice, and therefore greater rice demand.

Keywords: Supply and demand projections, computable general equilibrium, area allocation, agricultural supply, tariffication

Table of Contents

List of Figures

List of Tables

Scenarios for the Philippine agri-food system with and without Tariffication: Application of a CGE model with endogenous area allocation

Roehlano M. Briones[*]

1. Introduction

The Philippines has been undergoing a fundamental transformation of its economic structure. From being an agricultural economy after the Second World War, the country has evolved into a services- and industry-based economy. By 2017 only 8.4 percent of GDP was contributed by agriculture. Nonetheless, agriculture remains a paramount player in the livelihoods and food security of the poor (Briones, 2017a; Briones et al, 2017a). Understanding the future of agriculture is key to understanding the future of inclusive development in the Philippines.

Scenario-building for agriculture must address constraints owing to scarcity of resources, particularly land. Following the closure of the agricultural land frontier, Philippine agriculture has been compelled to raise land productivity to feed a burgeoning population. Increasing dependence on international trade has relieved much of the pressure; however, this raises a different set of challenges, as smallholders and fishers must confront the realities of global competition. In the Philippines, the most salient opportunity (or threat, depending on one's perspective) from global trade is the reform of rice policy by the conversion of quantitative restrictions (QRs) on imports into tariffs, i.e. *tariffication*.

An earlier scenario analysis by Briones (2013) introduced a aggregate land constraint into a multi-market model of the agricultural sectors of the Philippines, the Agricultural Model for Policy Evaluation (AMPLE). The analysis shows future patterns of land allocation, as well as the evolving structure of food demand, domestic production, and dependence on foreign markets. However, that analysis isolated agriculture from the rest of the economy, thereby missing out on the broader context of the agri-food system within a national economy.

The agri-food system was incorporated into the modeling framework using the AMPLE - Computable General Equilibrium Model (CGE), first described and applied in Briones (2017b). Some of the key findings of the are as follows:

- The current policy thrust for agriculture of subsidizing capital cost slightly accelerates growth of agriculture, but slows down overall growth by reducing capital formation.
- Maintaining productivity growth for industry-service at trend, notwithstanding weak growth of agriculture, suffices to reach government plan targets.
- Productivity growth of agriculture impacts strongly on agriculture itself, but not on the industry-services sectors; conversely, productivity growth in the latter strongly impacts on itself and GDP, but not on agriculture.

[*] Senior Research Fellow, Philippine Institute for Development Studies

- Policies should emphasize the acceleration of productivity growth in the long run across all sectors, but especially in agriculture.
- Currently, forward and backward linkages of agriculture matter little to economic growth, suggesting the need to increase growth interactions across the basic sectors based on a value chain approach.

The AMPLE-CGE has been updated for base year 2013, with projections up to the year 2030. It does not however have projections for crop area, unlike its partial equilibrium version, the AMPLE. The proposed study addresses this gap with an updated and extended version of AMPLE-CGE. It analysis a baseline scenario for the future of the Philippine economy and agri-food sectors from 2016 to 2030. It also analyses an alternative scenario involving the abovementioned policy reform, namely tariffication.

2. The model

2.1 Overview of AMPLE-CGE

The AMPLE-CGE is programmed in the General Algebraic Modeling System (GAMS) language. The sectors of the AMPLE-CGE model and corresponding GAMS label are presented in Table 1. Sets of the AMPLE-CGE are shown in Table 2.

Table 1: Sectors of the AMPLE-CGE

Sector	GAMS label
Agricultural sectors	
Palay	C_Palay
Corn	C_Corn
Coconut	C_Coconut
Sugarcane	C_Sugarcane
Banana	C_Banana
Mango	C_Mango
Other fruit	C_Otfruit
Other crops	C_Otcrop
Root crops	C_Rootcrop
Vegetables	C_Veg
Hogs	C_Hog
Other livestock	C_Otlivestock
Poultry	C_Poultry
Agricultural services	C_AgServ
Forestry	C_Forest
Capture fisheries	C_Captur
Aquaculture	C_Aquacult
Industrial sectors	
Mining	C_Mining
Rice	C_Rice
Meat	C_Meat
Processed fish	C_Procfish

Sector	GAMS label
Sugar	C_Sugar
Other food manufacturing	C_Otfoodmanuf
Beverage manufacturing	C_Bev
Pesticide manufacturing	C_Pest
Other agricultural manufacturing	C_Otagrimanuf
Feed manufacturing	C_Feeds
Other manufacturing	C_Otmanuf
Manufacturing of agricultural machinery	C_Manufagmachin
Other industry	C_Otindustry
Service sectors	
Transport services	C_Transpo
Storage services	C_Stor
Wholesale services	C_Wholesale
Finance services	C_Finance
Other private services	C_Otprivserv
Public services	C_Pubserv

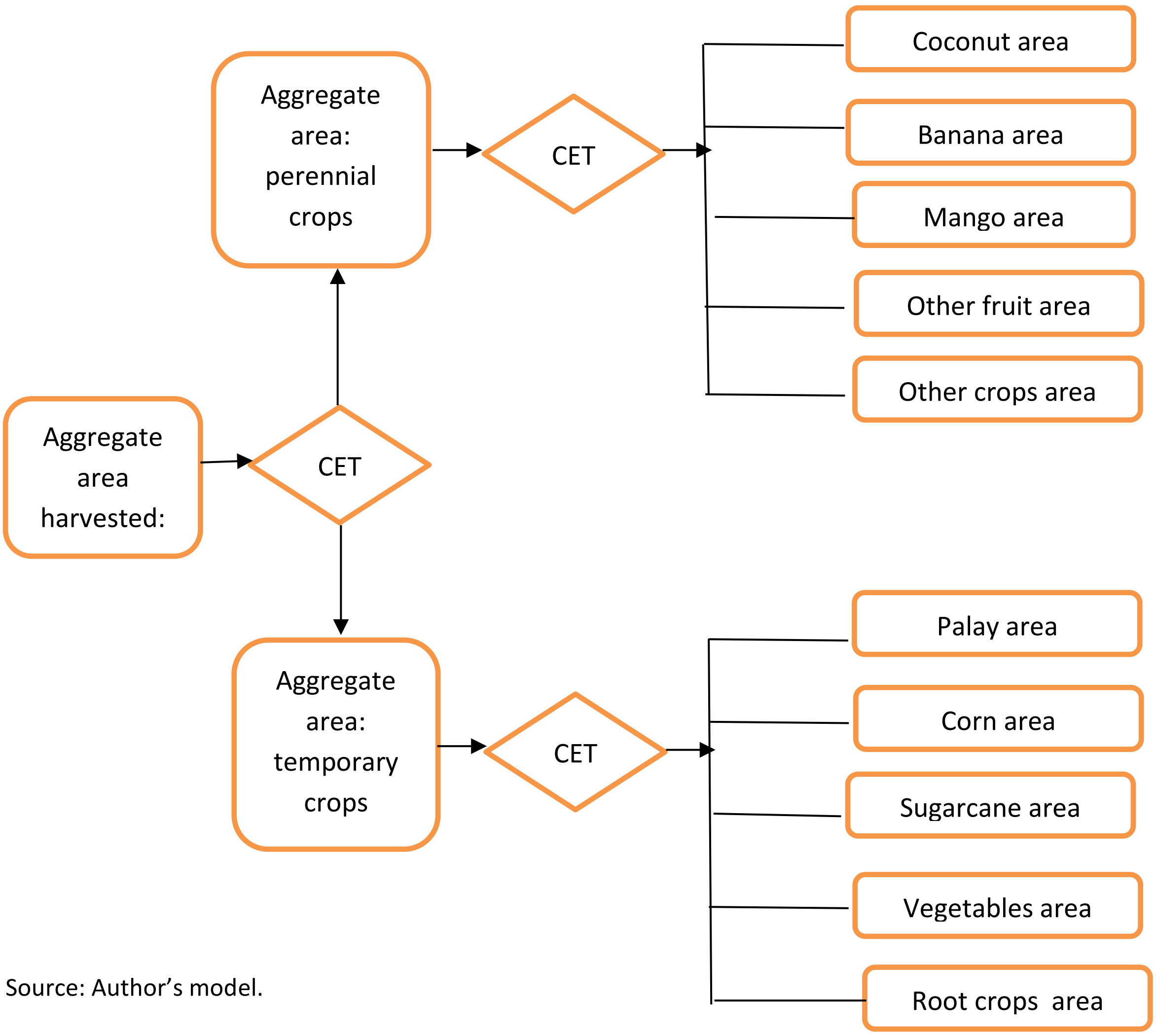
Table 2: Sets definitions in the AMPLE-CGE

Label	Definition	Relationship
Act	Activities	$Act \subset samacct$
$AgFd$	Industry sectors related to agriculture and food	$AgFd \subset G$
Ag	Agricultural sectors	$Ag \subset AgFd$
$AgCrN$	Non-crop agricultural sectors:	$AgCrN \subset Ag$
$AgCr$	Crop agricultural sectors	$AgCr \subset Ag$
$AgCrP$	Perennial crop sectors {Coconut, Banana, Mango, Other fruit, Other crops, Root crops}	$AgCrP \subset AgCr$
$AgCrT$	Temporary crop sectors{Palay, Corn, Sugarcane, Vegetables}	$AgCrT \subset AgCr$
$Factor$	Factors of production	$Factor \subset samacct$
$FactorC$	Capital Factors	$FactorC \subset Factor$
G	Goods, commodities	$G \subset samacct$
GM	Imported goods	$GM \subset G$
GMN	Goods not imported	$GMN \subset G$
GX	Exported goods	$GX \subset G$
GXN	Non-exported goods	$GXN \subset G$
H	Households—rural, urban	$H \subset samacct$
Ind	Industry sector	$Ind \subset IS$
IS	Industry and Services sector	$IS \subset G$
$GCrN$	Non-crop agriculture & industry & services	$AgCrN \cup IS$
$Labor$	Labor accounts	$Labor \subset Factor$
$Serv$	Service sector	$Serv \subset IS$

2.2 *Incorporating area allocation into AMPLE-CGE*

The AMPLE – CGE incorporates the original approach of AMPLE to crop supply, namely decomposing crop supply into area harvested and yield, based on a constant returns production function. Area is allocated subject to an aggregate land constraint, and with some rigidity (tuned by an appropriate parameter) in the re-allocation of land across crops. The schematic is summarized in Figure 1. The original framework has been generalized by a nested approach in which perennial crop areas are separately determined within in inner nest; temporary crop areas are also separately determined within an inner nest; and aggregate perennial crop area, together with aggregate temporary crop area, are themselves determined by an outer nest.

Figure 1: Schematic of the analytical framework for determination of area harvested by crop



Source: Author's model.

Aggregate area harvested is transformed into area harvested for perennial crops, and for temporary crops, following a constant elasticity of transformation (CET) function. The CET determines the degree of flexibility in re-allocation of land between these crop categories; the greater the value, the greater the flexibility. In turn, total area harvested for perennial (temporary) crops are transformed into the area harvested for the individual perennial (temporary) crop categories, also following a CET function with its respective elasticity term. Note that elasticity of transformation among temporary crops will tend to be higher in absolute terms than that among perennial crops, and even between aggregate area for perennial crops and aggregate area for temporary crops. The equations of the area and yield sub-model are described below.

2.3 Consumption block

The first block of the model is the consumption block (Table 3). The first two equations pertain to per capita expenditures and consumption. Equation C1 determines household consumption based on a Linear Expenditure System (LES), in which a household determines its total expenditure for a good by allotting a minimum amount of consumption, plus a fixed proportion of total expenditure net of subsistence consumption; subsistence consumption is itself the total value of minimum consumption. In equation form:

$$PD_G \cdot QC_{G,H} - PD_G \cdot qcmn_{G,H} = \beta_{G,H} \cdot \left(XPD_H - \sum_G PD_G \cdot qcmn_{G,H} \right)$$

Equation C2 obtains total subsistence expenditure; C3 converts per capita consumption to total consumption.

Table 3: Variables, constants, and equations of the 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
$XPDmn_H$	Subsistence expenditure per capita
Constants	
$qcmn_{G,H}$	Minimum household consumption per capita of G (subsistence)
$\beta_{G,H}$	Coefficient term in LES
pop_H	Population
$io_{G,GG}$	Matrix of technical coefficients
Equations	
C1.	$QC_{G,H} = qcmn_{G,H} + \frac{\beta_{G,H}}{PD_G} \cdot \left(XPD_H - \sum_G PD_G \cdot qcmn_{G,H} \right)$
C2.	$XPDmn_H = \sum_G PD_G \cdot qcmn_{G,H}$

C3.	$QDC_G = \sum_H QC_{G,H} \cdot pop_H$

2.4 Household block

The second block of the model is the household block, shown in Table 4. Equation H1 sums up total factor income of households as the value of capital endowment; plus the value of labor endowment, adjusted by a parameter θ for entry into employment from underemployed or surplus labor, assumed exogenous; plus return to land. H2 is the capital endowment of each household; H3 obtains disposable income by netting out the direct income tax, while adding transfers from government and rest of the world. H4, H5, and H6, simply derive, respectively: the household income tax, household savings, and per capita household expenditures.

Table 4: Variables, constants, and equations of the household block

Variables	
Y_H	Total household income
$KAPE_H$	Total household capital endowment
YD_H	Household disposable income per capita
SAV	Total savings of households
$YTAX$	Total tax on household income
PK	Price of capital
PLA	Price of agricultural labor
$PLIS$	Price of industry-service labor
Constants	
$kapst$	Baseline capital stock
$kapsh_H$	Ownership shares in capital stock
λAG_H	Agricultural labor endowment per household per capita
λIS_H	Labor endowment per household, industry-service, per capita
$nrevsh_H$	Net revenue share
yt_H	Direct tax rate on household
s_H	Savings rate of household
$gtranh_H$	Government transfers to households
$ftranh_H$	Foreign transfers to households (in USD)
Equations	

H1.	$Y_H = PKAP \cdot KAPE_H + \left[PLA \cdot \lambda AG_H \cdot pop_H \right] \cdot \theta + \left[PLIS \cdot \lambda IS_H \right] + \sum_H \sum_{AgCr} NREV_{AgCr} \cdot nrevsh_H$
H2.	$KAPE_H = kapsh_H \cdot kapst$
H3.	$YD_H = Y_H \cdot \left(1 - yt_H\right) + gtranh_H + ftranh_H$
H4.	$YTAX = \sum_H yt_H \cdot Y_H$
H5.	$SAV = \sum_H s_H \cdot YD_H$
H6.	$XPD_H = \dfrac{YD_H \cdot \left(1 - s_H\right)}{pop_H}$

2.5 Production block

The third block is the production block, shown in Table 5. For *IS* sectors, value added is produced using capital and labor by way of a constant elasticity of substitution (CES) function. Demand for labor is derived by applying cost-minimization on the CES production function (P2). Similarly, for *AgCrN*, value added is produced using capital and labor under CES (P3). Demand for labor is also derived by applying cost minimization (P3). Finally, demand for capital in both CES functions are likewise derived from cost minimization (P5).

In terms of equations: first, value added per unit area is a function of output and factor prices under a Cobb-Douglas formulation (P6). Total output (measured by value added) is obtained by the product of value added per unit area, and total area. Net revenue per ha is a constant share of total revenue per ha (P8).

Consider now the outer nest: applying cost-minimization on CET given fixed *hpt* determines *HP* and *HT* (respectively, P9 and P10). The shadow value of land on the aggregate is the sum of shadow values of aggregate perennial and aggregate temporary crop areas. An adjustment factor converts aggregate area into total area harvested (P12).

Consider the inner nest, first for perennials: applying cost-minimization on a CET function determines area of individual perennial crops (P13). The shadow value of perennial land equals the total net revenue earned by perennial crops (P14). Analogous equations apply to temporary crops (P15 and P16).

Demand for labor and capital for the crops are fixed factor shares of value added (respectively, P17 and P18). Total value added is the sum of factor payments plus net revenue from land (P19). Across all sectors, value added is a fixed proportion of gross output (P20). Lastly, the indirect domestic tax is assumed to be levied on value added (P21).

Table 5: Variables, constants, and equations of the production block

Variables	
LA_{Ag}	Agricultural labor
LIS_{IS}	Industry-service labor

KAP_G	Capital demand
QS_G	Domestic supply
PS_G	Price of domestic supply
$VATAX$	Total domestic indirect tax
PVA_G	Price of value added per good
QVA_G	Quantity of value added per good
YVA_{AgCr}	Value added for crops per unit area
$NREV_{AgCr}$	Net revenue for crops per unit area
YLA_{AgCr}	Labor demand for crops per unit area
$YKAP_{AgCr}$	Capital demand for crops per unit area
HC_{AgCr}	Area harvested by crop
HP	Area harvested for all perennial crops
HT	Area harvested for all temporary crops
$LAMP$	Shadow price of land area for perennials
$LAMT$	Shadow price of land area for temporary crops

Constants

αLA_{AgCrN}	Labor parameter in CES VA function for non-crop agriculture
αLIS_{IS}	Labor parameter in CES VA function for industry-service
$\alpha KAP_{AgCrNIS}$	Capital parameter for non-crop agriculture and industry-service
σVA_{GCrNIS}	Elasticity of substitution for non-crop agriculture and industry-service
ρVA_{GCrNIS}	Parameter in CES function for non-crop agriculture and industry-service
$\alpha LACr_{AgCr}$	Crop yield elasticity parameter for labor in crops
$\alpha KAPCr_{AgCr}$	Crop yield elasticity parameter for capital in crops
αS_{AgCr}	Sum of labor and capital output elasticities for crops
σHP	Elasticity of substitution of land area among perennial crops
σHT	Elasticity of substitution of land area among temporary crops
σH	Elasticity of substation of land area between perennial and temporary crops
uva_G	Value added per unit gross output
vat_G	Implicit value added tax (net of subsidies)
sub_G	Subsidy per unit capital (in ad valorem terms)
hpt	Total area harvested
θpt	Adjustment factor from aggregate area to total land area

Equations

P1 $$QVA_{IS} = \left(\alpha LIS_{IS} \cdot LIS_{IS}^{-\rho VA_{IS}} + \alpha KAP_{IS} \cdot KAP_{IS}^{-\rho VA_{IS}}\right)^{\frac{-1}{\rho VA_{IS}}}$$

P2	$LIS_{IS} = QVA_{IS} \cdot \left(\alpha LAB_{IS} \dfrac{PVA_{IS}}{PLIS} \right)^{\sigma VA_{IS}}$
P3	$QVA_{AgCrN} = \left(\alpha LA_{AgCrN} \cdot LA_{AgCrN}^{-\rho VA_{GCrN}} + \alpha KAP_{AgCrN} \cdot KAP_{AgCrN}^{-\rho VA_{GCrN}} \right)^{\frac{-1}{\rho VA_{AgCrN}}}$
P4	$LA_{AgCrN} = QVA_{AgCrN} \cdot \left(\alpha LA_{AgCrN} \dfrac{PVA_{AgCrN}}{PLA} \right)^{\sigma VA_{AgCrN}}$
P5	$KAP_{AgCrNIS} = QVA_{AgCrNIS} \cdot \left(\alpha KAP_{AgCrNIS} \dfrac{PVA_{AgCrNIS}}{PKAP} \right)^{\sigma VA_{AgCrNIS}}$
P6	$YVA_{AgCr} = \left[PVA_{AgCr}^{\alpha S_{AgCr}} \cdot \alpha 0_{AgCr} \cdot \left(\dfrac{\alpha LA_{AgCr}}{PLA} \right)^{\alpha LA_{AgCr}} \cdot \left(\dfrac{\alpha KAP_{AgCr}}{PKAP} \right)^{\alpha KAP_{AgCr}} \right]^{\frac{1}{1-\alpha S_{AgCr}}}$
P7	$QVA_{AgCr} = YVA_{AgCr} \cdot HC_{AgCr}$
P8	$NREV_{AgCr} = PVA_{AgCr} \cdot YVA_{AgCr} \cdot \left(1 - \alpha S_{AgCr}\right)$
P9	$HP = hpt \cdot \left(LAM \cdot \dfrac{\gamma P}{LAMP} \right)^{\sigma H}$
P10	$HT = hpt \cdot \left(LAM \cdot \dfrac{\gamma T}{LAMT} \right)^{\sigma H}$
P11	$LAM \cdot hpt = LAMP \cdot HP + LAMT \cdot HT$
P12	$hpt = \theta HT \sum_{AgCr} HC_{AgCr}$
P13	$HC_{AgCrP} = HP \cdot \left(LAMP \cdot \dfrac{\gamma_{AgCrP}}{NREV_{AgCrP}} \right)^{\sigma HP}$
P14	$LAMP \cdot HP = \sum_{AgCrP} NREV_{AgCrP} \cdot HC_{AgCrP}$
P15	$HC_{AgCrT} = HT \cdot \left(LAMT \cdot \dfrac{\gamma_{AgCrT}}{NREV_{AgCrT}} \right)^{\sigma HT}$
P16	$LAMT \cdot HT = \sum_{AgCrT} NREV_{AgCrT} \cdot HC_{AgCrT}$
P17	$PLA \cdot LA_{AgCr} = \alpha LAB_{AgCr} \cdot PVA_{AgCr} \cdot QVA_{AgCr}$
P18	$PKAP \cdot KAP_{AgCr} = \alpha KAP_{AgCr} \cdot PVA_{AgCr} \cdot QVA_{AgCr}$
P19	$PVA_{AgCr} \cdot QVA_{AgCr} = PKAP \cdot KAP_{AgCr} + PLA \cdot LAB_{AgCr} + NREV_{AgCr} \cdot HC_{AgCr}$
P20	$uva_G \cdot QS_G = QVA_G$
P21	$VATAX = \sum_G vat_G \cdot PVA_G \cdot QVA_G$
P22	$PS_G = PVA_G \cdot \left(1 + vat_G\right) \cdot uva_G + \sum_{GG} \left(io_{GG,G} \cdot PD_{GG} \right)$

2.6 Trade block

The third block is the trade block (Table 6). The domestically produced version of good *G* is called the “home” good; the good demanded is a composite of home and imported goods. The price of the imported product is given in T5; the world price is converted to Philippine peso using the exchange rate, taking into account an *ad valorem* tariff, and a further wedge due to non-tariff barriers (also assumed to have an *ad valorem* effect). The counterpart for the export price is T6, which far simpler in absence of export taxes and assuming away non-tariff barriers on the supply side. The composite prices on demand side and supply side are given in T7 and T8, respectively. T9 computes the total import taxes collected.

Table 6: Variables, constants, and equations of the trade block

Variables	
QD_G	Total domestic demand (domestic absorption)
QDH_G	Demand for goods from home supplier
QDF_G	Import quantity (demand for goods from foreign supplier)
QSH_G	Supply of goods for home market
QSF_G	Export quantity (supply of goods for foreign buyer)
$PUSD$	Price of USD in PHP (exchange rate)
PM_G	Border price of imported good
PH_G	Price of home supplied good for home market
PX_G	Border price of exported good
$MTAX$	Total taxes on imports
Constants	
pwm_G	World price (in USD) of imported good
pwx_G	World price (in USD) of exported good
tar_G	Implicit tariff rate
δDH_G	Coefficient in Armington composite for home source
δDF_G	Coefficient in Armington composite for imports
σD_G	Elasticity of substitution in Armington composite
δSH_G	Coefficient in CET composite for home destination
δSF_G	Coefficient in CET composite for foreign destination
σS_G	Elasticity of transformation in CET composite
ntb_G	Non-tariff barrier effect on price

Equations

T1. $$QDH_G = QD_G \left(\frac{\delta DH_G \cdot PD_G}{PH_G} \right)^{\sigma D_G}$$

T2. $$QDF_{GM} = QD_{GM} \left(\frac{\delta DF_{GM} \cdot PD_{GM}}{PM_{GM}} \right)^{\sigma D_{GM}} \; ; \; QdF_{GMN} = 0$$

T3. $$QSH_G = QS_G \left(\frac{PH_G}{\delta SH_G \cdot PS_G} \right)^{\sigma S_G}$$

T4. $$QSF_{GX} = QS_{GX} \left(\frac{PX_{GX}}{\delta SF_{GX} \cdot PS_{GX}} \right)^{\sigma S_{GX}} \; ; \; QSF_{GXN} = 0 .$$

T5. $$PM_G = pwm_G \cdot PUSD \cdot \left(1 + tar_G + ntb_G\right)$$

T6. $$PX_G = pwx_G \cdot PUSD$$

T7. $$PD_G \cdot QD_G = PH_G \cdot QDH_G + PM_G \cdot QDF_G$$

T8. $$PS_G \cdot QS_G = PH_G \cdot QSH_G + PX_G \cdot QSF_G$$

T9. $$MTAX = \sum_G tar_G \cdot pwm_G \cdot PUSD \cdot QDF_G$$

2.7 Other demand

The fifth block is the other demand block (Table 7). Total intermediate demand is the sum of intermediate demands from the gross outputs based on the appropriate technical coefficients (OD1). Expenditures on investment goods is a fixed share of total savings, based on the capital allocation coefficient (OD2). Similarly, government consumption expenditures is a fixed share of total government expenditures, which is fixed (OD3).

Table 7: Variables, constants, and equations of the other demand block

Variables

$QDINV_G$	Investment demand
$QDGOV_G$	Government consumption demand
$TSAV$	Total savings

Constants

cac_G	Capital allocation coefficient
$gxpd$	Total government consumption expenditure
γ_G	Shares in government consumption
$ftrang$	Foreign transfers to government (in USD)

Equations

OD1. $QDINT_G = \sum_{GG} io_{G,GG} \cdot QS_{GG}$

OD2. $PD_G \cdot QDINV_G = cac_G \cdot TSAV$

OD3. $PD_G \cdot QDGOV_G = \gamma_G \cdot gxpd$

OD4. $QD_G = QDINT_G + QDC_G + QDINV_G + QDGOV_G$

2.8 Other institutions block

The sixth block is the other institutions block (Table 8). Government savings is total revenues (taxes on income, business, and imports, together with transfers from foreign governments), net of expenditures, total transfers to households, and subsidies (OI1). Foreign savings is value of imports in pesos, net of import taxes, less value of exports, and transfers to households and government from rest of the world (OI2); foreign savings is exogenous to the model and posits the identity between base data foreign savings and normal capital inflows, along with an open foreign exchange market. Imposition of (OI2) leads to the equilibrium exchange rate. Total savings sums up savings of households, government, and rest of the world (OI3).

Table 8: Variables, constants, and equations of the other institutions block

Variables

$SAVG$	Savings of government (from consumption and income)

Constants

$savf$	Savings of foreign

Equations

OI1.
$$SAVG = YTAX + VATAX + MTAX + ftrang \cdot PUSD - \left(\sum_G PD_G \cdot QDGOV_G + \sum_H gtranh_H + \sum_G sub_G \cdot PKAP \cdot KAP_G \right)$$

OI2.
$$savf = \sum_G pwm_G \cdot QDF_G - \left[\sum_G PX_G \cdot QSF_G + \left(\sum_H ftranh_H + ftrang \right) \right]$$

OI3. $TSAV = SAV + SAVG + savf \cdot PUSD$

2.9 Other closure block

The final block is the Other closure block (Table 9). Total demand for capital equals the total stock of capital (OC1); likewise the total labor demand equals the total available labor (OC2 and OC3). The demand for domestically produced version of a good equals the domestically supplied version of the good (OC4). Owing to non-uniqueness of the equilibrium price vector, a definite solution is found by minimizing the sum of squared deviation between the solution price and base data price, weighted by the base data shares (OC5).

Table 9: Variables and equations of the other closure block

Constants	
$PD0_G$	Price of demand good at the base data
$wcpi_G$	Consumption share of G at the base data
$CPI0$	Average of consumer prices (weighted by consumption shares)
Equations	
OC1.	$\sum_G KAP_G = \sum_H KAPE_H$
OC2.	$\sum_{Ag} LA_{Ag} = \sum_H \lambda AG_H \cdot pop_H \theta$
OC3.	$\sum_{Ag} LIS_{IS} = \sum_H \lambda IS_H \cdot pop_H$
OC4.	$QSH_G = QDH_G$
OC4.	$CPI0 = \sum_G wcpi_G \cdot PD0_G$

3. Data set and scenarios

3.1 Base data set and calibration

The GAMS program to run AMPLE CGE is available for free download (https://tinyurl.com/y93m8c47). A User's Guide will be prepared, updating Galang (2017). The guide, together with downloaded files, will allow a user to replicate the scenarios analysis described below.

The base data of the model will be compiled for 2016. The latest input-output table for the Philippines is for 2012 in 65 sectors. An input-output table for 2016 will be constructed by applying growth rates of gross value added (GVA) of the consolidated accounts categories (in current prices) from 2012 to 2016, along with intermediate inputs and final demands. Other national accounts data are incorporated into the preliminary SAM based on the updated input-output table. The return to land by crop is a fixed share of gross surplus, based on related cost and returns data of PSA (2018a). Following the original AMPLE, this return is a fixed share of value added; return to capital in each sector must thereby adjust accordingly to add up to the operating surplus account derived from the official input-output table. A modified RAS method is used to balance the updated SAM, with final balance obtained by adjustment of individual cell entries.

Capital stock is obtained using investment accumulation technique using the 1946 – 2010 and then 2011 – 2016 real investment time series, based on 5.8% discount rate. The differential between agriculture and industry-service wage is based on PSA (2016).

Additional information will be incorporated into the base data set in the form of yield and area formulation. Note that prices are normalized to unity (Php one million pesos) by re-specifying physical units. Based on data on area harvested and physical outputs from PSA, the implicit unit area and unit output will be estimated for the base data set; and hence the implicit output per unit area (or modified yield). Note that these base data estimates will not be reported; what will be reported instead will percentage changes for each set of projections.

The parameters of the model described in Section 2 are calibrated to the resulting base data. A solution is found for the resulting equation system using GAMS Conopt Solver; this solution is confirmed to very closely approximate the base data. Thus properly calibrated, we can now proceed to the analysis of scenarios.

3.2 Baseline and alternative scenarios

To develop the baseline scenario, an equilibrium solution is found for periods 2016 (the base period) to 2030, the Sustainable Development Goals (SDGs) end-year; the periods are denoted t = 2016, ..., 2030. Each additional year after the base period involves an updating of exogenous variables corresponding to that period. In principle, all the constants and parameters in Section 2 may be varied from period to period. For the baseline scenario we isolate the following

a) Capital stock
b) Population
c) Growth rate of world prices
d) Growth of aggregate crop area
e) Technology parameters
f) Government consumption

For a), capital stock is updated by the equation:

$$kapst_{t+1} = kapst_t \cdot (1 - dep) + adj_t \cdot \sum_G PD_{G,t} \cdot QDINV_{G,t}$$

The adjustment term accommodates the transformation from investment flows to productive capital stock. For b), updating is based on population projections from PSA (2018). For c), only export prices for banana was shocked, given its projected change in world price according to World Bank (2018). Growth rate of world banana price is set at 1 percent per annum for the projection period. For d), a small exogenous growth rate of 0.1 percent per year was assumed. For e), exogenous growth of productivity was imposed for industry-service sectors, along the magnitudes used in Briones (2017). Lastly, for f), a significant 4 percent annual growth (in real terms) was adopted in line with recent budgets.

Note that aside from government consumption, no other policy change is incorporated in the baseline scenario; in particular, the *ntb* term is held constant throughout the baseline. This permits a policy experiment to define the alternative scenario, called Tariffication. The *ntb* term for rice imports is counterfactually allowed to decline (at a rate of 20 percent per year) over the projection period.

The experiment is related to an imminent policy reform, yet to be implemented, namely tariffication. The Congress Bicameral Conference Committee Report dated November 28, 2018 had adopted a draft consolidated law, which will be enacted upon signature by the President (expected on early 2019). The draft law eliminates QRs in rice importation, replacing it with a tariff regime of 35 percent for ASEAN imports; 40 percent tariffs in-quota; and a tariff ceiling of 180 percent out-quota (though a *status quo* applied tariff of 50 percent is likely to prevail). Government authority to control imports through import permits, currently administered by the National Food Authority (NFA), is repealed. The draft law further revokes all regulatory powers of NFA, limiting their mandate entirely to buffer stocking. The remaining regulation over rice imports is the sanitary and phytosanitary import clearance issued by the Bureau of Plant Industry (BPI). The law further enables automatic import clearance should BPI fail to act on an import clearance application.

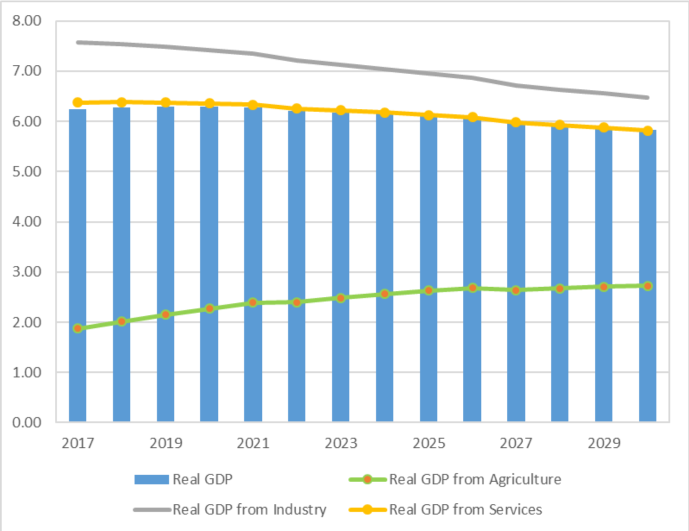
The draft law implies a comprehensive dismantling of non-tariff barriers (NTBs) upon effectivity. Unfortunately, the equation system has proven difficult to solve when subjected to a large policy shock (i.e. complete elimination of the NTB); this is a well-known problem of finding a solution to a large nonlinear system when starting values are too far from the solution values. Instead our policy experiment hypothesizes implementation of the NTB removal at a more gradual rate over the entire projection period. By 2030, the NTB has the effect of only 4.4 percent of its original base level.

4. Results

4.1 Baseline scenario

National economy and basic sectors. Real GDP is projected to growth at around 6 percent (Figure 2), with average of 6.12 percent. Growth is powered by industry, whose expansion hovers at 6.5 to 7.5 percent (averaging 7.07 percent). Services grow at very nearly the overall GDP growth (averaging 6.16 percent). The laggard basic sector is agriculture, whose growth ranges at 2 to 3 percent (averaging 2.44 percent). These growth rates are consistent with historical performance in the 2010s.

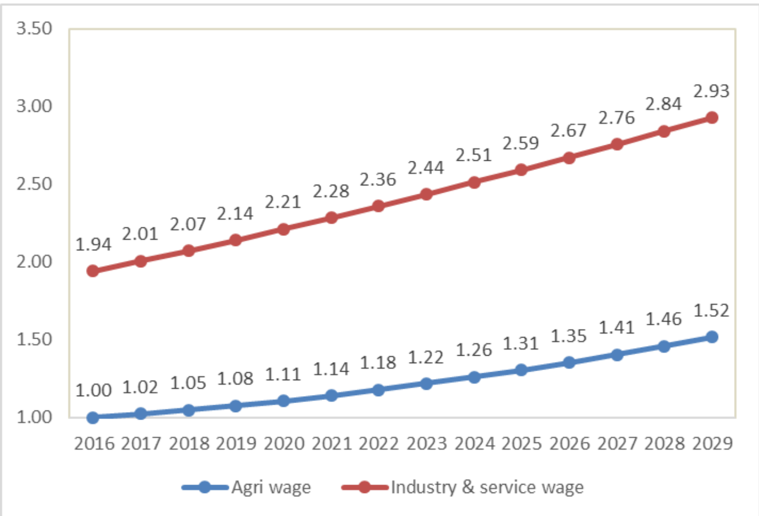
Figure 2: Projected growth rates of GDP, basic sectors, baseline scenario, 2016-2030 (%)



Source: Author's calculation.

Real wages. An indicator of the degree to which projected GDP growth is include is found in real wages (Figure 3). Both agricultural wages and wages in industry-service grow at similar rates (averaging 3.3 and 3.2 percent, respectively). This is fortunate as it demonstrates that weak growth of agriculture need not cause stagnation in agricultural wages, owing to increasing demand for labor in agriculture. However, at the base, industry-service wage is 1.94 times higher than that of agricultural wage; hence by 2030, the divergence between the two wages remains very wide (91 percent, virtually identical to the base data).

Figure 3: Projected growth rate of wages, by labor category, baseline scenario, 2016-2030 (%)

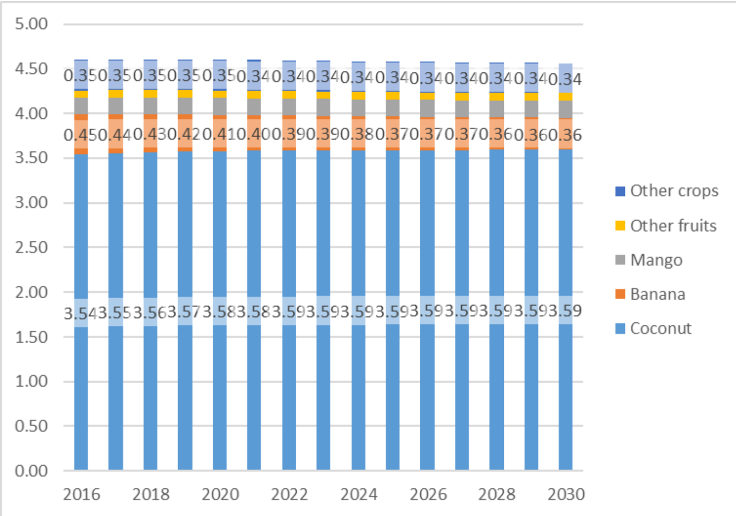


Source: Author's calculation

Crop area. We consider first the area harvested of perennial crops (Figure 4), consisting of Coconut, Banana, Other fruits, and Other crops. On the base year the total area harvested is 4.60 million ha, virtually unchanged throughout the projection period (ending up at 4.56 million ha by 2030). This area is dominated by Coconut at 3.54 million ha; its share rises over time, gaining about fifty thousand ha by 2030. The increase is accompanied by a contraction of the other perennials, except Other fruits. The sharpest contraction is suffered by Banana, which shrinks by a rate of 1.6 percent per year over the period.

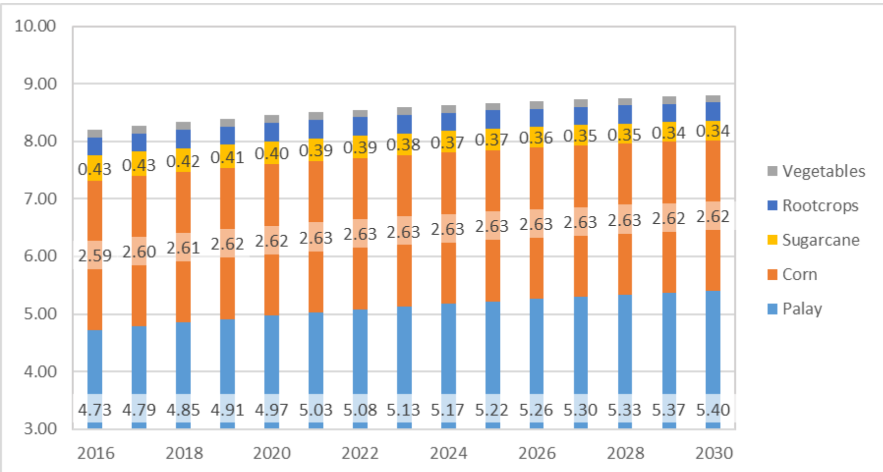
Next we consider the temporary crops (Figure 5). Unlike perennial crops, temporary crops experience a significant expansion in area, from 8.2 million ha at the base, to 8.8 million ha by 2030. The total area harvested for both crop categories rises from 12.80 million ha to 13.37 million ha, a 1.4 percent increase (which corresponds to the assumed growth rate of 0.1 percent per year over the projection period). Clearly this increase was captured by temporary crops, which also receives a small re-allocation in area harvested from perennials.

Figure 4: Projected area harvested of perennial crops, baseline scenario, 2016-2030 (million ha)



Source: Author's calculation

Figure 5: Projected area harvested of temporary crops, baseline scenario, 2016-230 (millions of ha)

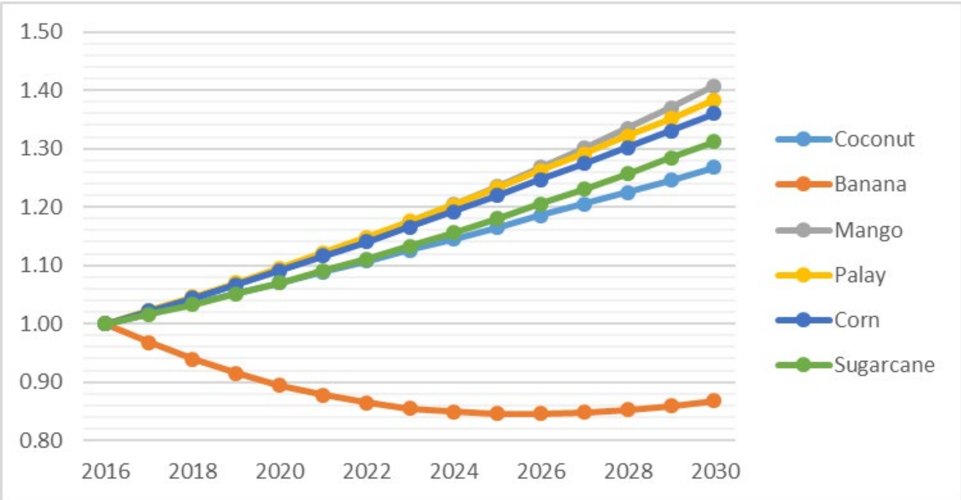


Source: Author's calculation.

Among the temporary crops, the increase in area is led by palay, whose area harvested by 2030 is 14 percent greater than at base. Corn area also increases, gaining about 0.03 million ha within the projection period. However, area harvested for sugarcane suffers a decline; there is also a small diminution of area harvested for vegetables (4.15 percent contraction).

Crop yield. The yield index for major crops is shown in Figure 6; note that crop categories that combine numerous heterogeneous crops (i.e. Other fruit, Other crops, etc.) are excluded. Moreover, yield improvements are entirely due to intensification (more primary and intermediate inputs per ha) rather than changes in technology. In turn, changes in input intensity depend on relative price changes. According to the Figure, Banana yield is set to decline, whereas the yield of the other crops increase. The yield decline for banana is consistent with reduced input intensity per ha, as well as reduced overall hectarage over the period.

Figure 6: Yield index of crops, baseline scenario, 2016-2030



Source: Author's calculation.

The largest yield improvement is expected for mango, where yield rises by over forty percent compared to the base. The second highest is for palay; using the projection estimates, palay yield rises to 5.35 tons per ha by 2030, up from 3.87 tons per ha at the base. The projected yield by 2030 is still lower than the 2017 yield in Vietnam (5.55 tons per ha).

Output and exports of agri-food sectors. Projections for output (measured by value added) by AMPLE-CGE sector are shown in Table 10, which is limited to sectors within the agri-food system. Also displayed are export trends, for agri-food sectors that have significant exports at the base (or growth at the baseline scenario). In general, output growth is positive for the agri-food sectors, with the exception of Banana; output of both Sugarcane production and Sugar milling contract initially (to 2020), but eventually turn positive. None of the agri-food sectors achieve the growth rate of overall GDP, with the exception of Agricultural machinery.

Most of the agricultural sectors experience a decline in export growth; this is likely due to rising domestic demand (see discussion below). The agri-related industries are more likely to show positive export growth; in particular, manufacturing of Beverages, Pesticides, and Agricultural machinery, grow consistently over the projection period.

Table 10: Projected growth of value added and exports, agri-food sectors, baseline scenario, 2016-2030 (%)

	Value added			Exports		
	2017-20	**2021-25**	**2026-30**	**2017-20**	**2021-25**	**2026-30**
Palay	3.6	3.4	3.0	-1.0	-2.2	-3.2
Corn	2.5	2.3	2.1	-1.7	-2.9	-3.8
Coconut	2.0	1.8	1.7	-3.7	-4.8	-5.5
Sugarcane	-0.2	0.0	0.5	-3.8	-4.3	-4.5
Banana	-5.0	-2.7	-0.3	-7.2	-6.0	-4.4
Mango	2.4	2.5	2.6	-2.1	-2.4	-2.7
Other fruit	3.4	3.3	3.2	-1.0	-1.6	-2.1
Other crop	1.4	1.3	1.4	-3.0	-4.0	-4.6
Root crops	2.8	2.7	2.6	-2.3	-3.0	-3.5
Vegetables	2.3	2.4	2.6	-1.8	-2.1	-2.3
Hog	3.7	3.6	3.4	..	..	..
Other livestock	3.5	3.4	3.3	-0.1	-0.8	-1.4
Poultry	3.6	3.5	3.3	0.0	-0.8	-1.4
Capture fisheries	1.4	1.9	2.2	..	..	..
Aquaculture	2.5	3.1	3.5	-1.1	-1.0	-1.1
Rice	3.6	3.4	3.0	1.0	-0.1	-1.2
Meat	3.9	3.8	3.5	1.5	0.8	0.2
Processed fish	-1.2	-0.3	0.5	-2.4	-1.7	-1.1
Sugar	-0.2	0.0	0.5	-2.3	-2.5	-2.4
Other food manufacturing	1.2	1.0	1.1	0.4	-0.1	-0.3
Beverages	3.5	3.7	3.8	3.2	3.3	3.3
Pesticides	2.6	2.7	2.8	2.9	3.0	3.0
Feeds	3.3	3.1	2.8	0.2	-0.8	-1.7
Agricultural machinery	5.4	5.6	5.7	5.4	5.6	5.6

Source: Author's calculation.

Consumer demand is fairly robust over the projection period (Table 11). Consumer demand growth ranges from 3 to 4 percent across most of the agri-food sectors, approaching 5 percent for Beverages. In particular, Banana consumption demand rises consistently over the projection period; however, its consumption growth is not enough to boost its output. This is due to the high proportion of domestic supply being allocated to the export market, which is not expected to exhibit the same pace of demand growth for Philippine banana as the domestic market. Note that rising demand can explain in part the decline in exports, as production for the foreign market is shifted to production for the local market.

Also shown in the Table are consumer price projections; recall that these changes contain no inflationary effects as the consumer price index is held constant at the base value. All agri-food sector prices experience rising consumer price, except for Beverages, whose productivity growth apparently drives prices down over the projection period.

The final set of projections is presented for imports of the agri-food sectors (Table 12). Import demand growth is also robust over projection period. Indeed, the scenario implies increasing dependence on foreign suppliers to meet the country's future food demand. Import growth for rice in particular rises from 5.3 up to 5.7 percent; similar trends are projected for corn and meat. Somewhat higher import growth estimates are expected for Other fruit, Vegetables, Poultry, and Aquaculture; meanwhile somewhat lower import growth is expected for Sugar, Pesticides, Beverages, and Other food manufacturing.

Table 11: Projected growth of consumer demand and price, agri-food sectors, baseline scenario, 2016-2030 (%)

	Consumer demand			Consumer price		
	2017-20	**2021-25**	**2026-30**	**2017-20**	**2021-25**	**2026-30**
Corn	3.6	3.3	2.9	1.6	2.0	2.2
Coconut	3.1	2.7	2.2	2.6	3.0	3.3
Sugarcane	3.6	3.3	3.0	1.6	1.9	2.1
Banana	1.5	1.5	1.4	5.7	5.3	4.6
Mango	3.3	3.1	2.8	2.3	2.4	2.4
Other fruit	3.7	3.6	3.3	1.4	1.5	1.6
Other crop	4.0	4.0	3.8	0.8	0.9	0.9
Root crops	3.2	3.0	2.6	2.3	2.6	2.7
Vegetables	3.4	3.2	2.9	2.1	2.2	2.2
Poultry	3.6	3.4	3.1	1.6	1.9	2.1
Capture fishery	3.5	3.3	2.9	1.8	2.0	2.2
Aquaculture	3.5	3.3	3.0	1.8	1.9	2.0
Rice	4.1	3.9	3.6	0.7	0.9	1.1
Meat	4.0	3.9	3.6	0.8	0.9	1.1
Processed fish	3.8	3.8	3.8	1.3	1.1	0.9
Sugar	3.8	3.8	3.6	1.2	1.2	1.2
Other food manufacturing	4.2	4.2	4.1	0.3	0.3	0.3
Beverages	4.5	4.6	4.6	-0.1	-0.2	-0.2

Source: Author's calculation.

Table 12: Projected growth of imports, agri-food sectors, baseline scenario, 2016-2030 (%)

	2017-20	**2021-25**	**2026-30**
Corn	5.3	5.7	6.0
Coconut	5.7	6.2	6.5
Other fruit	6.6	6.9	6.9
Other crop	6.2	6.4	6.4
Vegetables	5.9	6.1	6.3
Poultry	5.9	6.2	6.4

	2017-20	2021-25	2026-30
Capture fishery	4.0	4.9	5.5
Aquaculture	5.7	6.5	7.0
Rice	5.3	5.6	5.7
Meat	5.6	5.8	5.8
Processed fish	5.6	5.7	5.7
Sugar	4.8	4.9	5.0
Other food manufacturing	4.6	4.8	4.9
Beverages	3.8	4.1	4.3
Pesticides	2.3	2.5	2.5
Feeds	5.4	5.7	5.8
Agricultural machinery	5.3	5.6	5.7

Source: Author's calculation.

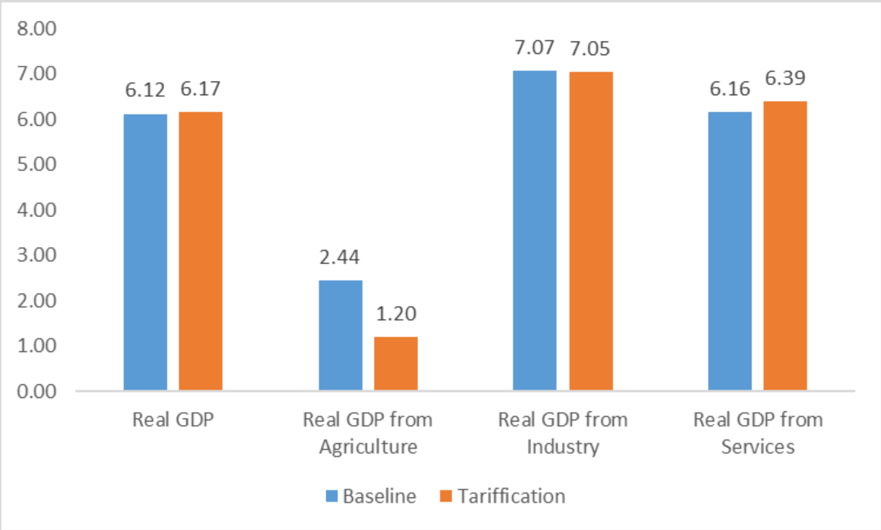
4.2 *Tariffication scenario*

Output growth by basic sector. Average output growth by basic sector for both tariffication and baseline scenarios is shown in Figure 7. Not surprisingly, tariffication introduces only a miniscule difference in real average GDP growth (the difference being a 0.5 percentage point increase). Similarly, growth in industry GDP is also slightly affected, though this time negatively (0.2 percentage points on average). Rice milling is adversely impacted by increased imports of milled rice.

A much greater impact is felt on the agricultural sector itself, whose growth suffers a 1.24 percentage point slowdown over the projection period. Fortunately, the services sector GDP grows slightly faster by 0.23 percentage points; the reason is likely due to higher purchasing power of households as rice gets cheaper due to lower import barriers (see below).

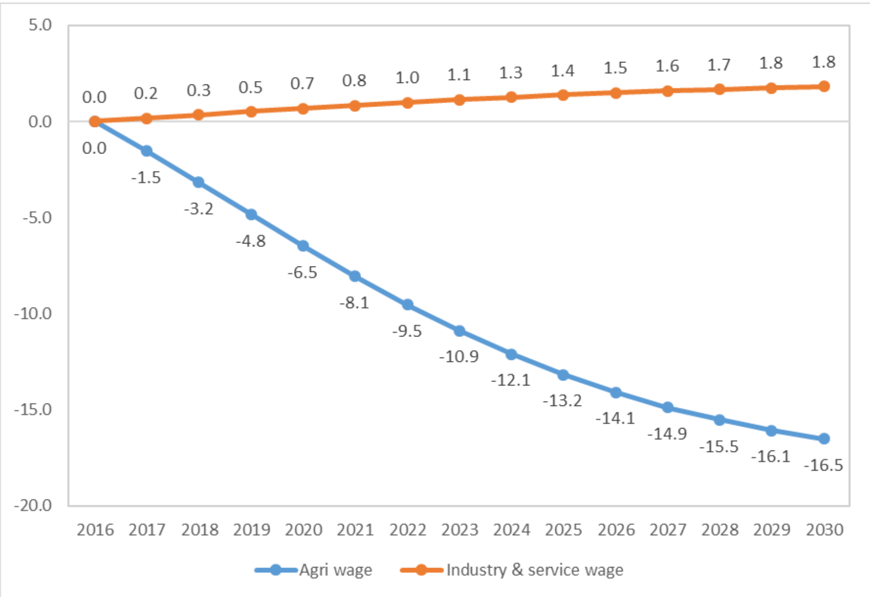
Wages and welfare. The change in wage index (in real terms) between tariffication and baseline scenarios is shown in Figure 8. The industry-service wage rises faster in the tariffication scenario, such that by 2030 it is 1.8 percent higher than at the baseline. However, the reverse trend occurs for the agriculture wage, with a much greater magnitude of effect; by 2030 wages in agriculture are 16.5 percent lower under tariffication compared with the baseline. Given only slight improvement in output compared to a large deterioration in agricultural wage, it is not clear that household welfare has improved.

Figure 7: Average growth rates of GDP, basic sectors, baseline and tariffication scenarios, 2016-2030 (%)



Source: Author's calculation.

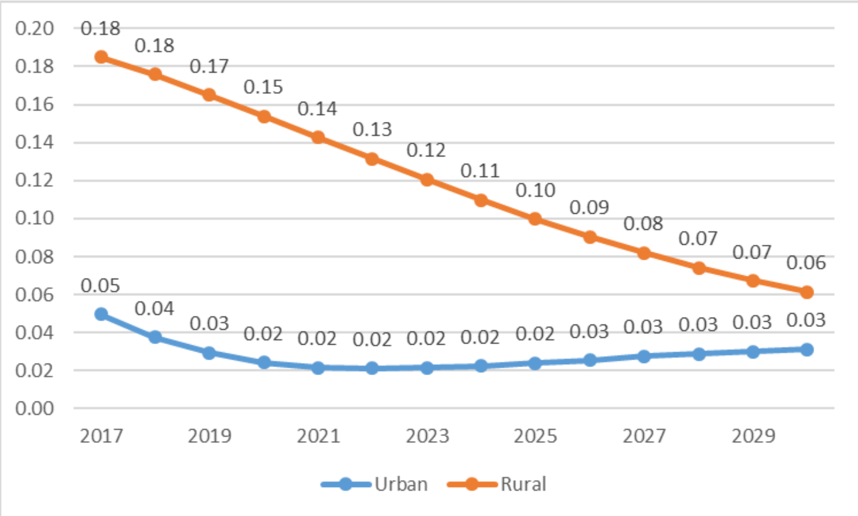
Figure 8: Percentage difference of wage index, tariffication versus baseline scenarios, 2016-2030



Source: Author's calculation.

One indicator to check for change in household welfare is household expenditure per capita (as explained previously, all changes in economic value are in already real terms). Comparing household per capita expenditure between tariffication and baseline (Figure 9), we find that the variable grows faster in the former than in the latter. The positive difference holds for both urban and rural households. Indeed, the difference in growth rates is larger for the latter than the former. Hence, despite lower agricultural wages, tariffication allows for faster growth in household expenditures, even for rural households, owing to a greater purchasing power.

Figure 9: Difference in growth of household expenditure per capita, tariffication versus baseline scenarios, 2016 – 2030 (%)



Source: Author's calculation.

Crop area and yield. Table 13 contrasts the distribution of aggregate area between baseline and tariffication scenarios. As seen previously, the share of temporary crops is expected to rise under the baseline scenario, at the expense of perennial crops; among the former, the area share of Palay will rise, while those of other temporary crops decline. Meanwhile among the perennials, that of Banana declines most prominently, while those of Coconut and Mango increases.

Table 13: Shares in total crop area, baseline and tariffication scenarios, 2016 and 2030 (%)

	2016	Baseline, 2030	Tariffication, 2030
Perennial crops	36.0	34.1	35.0
Coconut	76.9	78.7	79.0
Banana	9.7	7.9	8.5
Mango	4.1	4.2	3.7
Other fruits	1.8	1.8	1.8
Other crops	7.5	7.4	7.0
Temporary crops	64.0	65.9	65.0
Palay	57.7	61.3	60.8
Corn	31.6	29.8	29.3
Sugarcane	5.3	3.8	4.5
Rootcrops	3.8	3.6	3.8
Vegetables	1.6	1.5	1.6

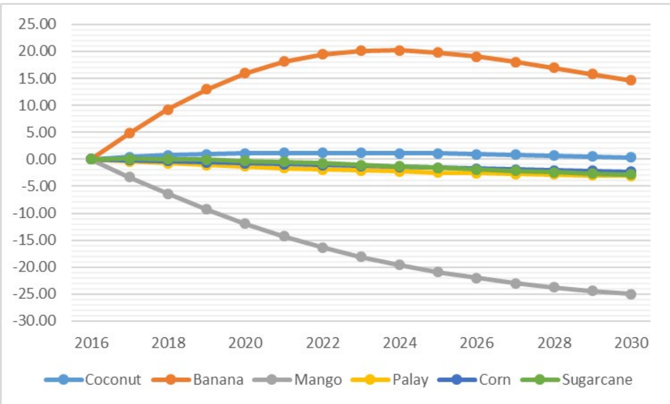
Source: Author's calculation.

For tariffication, the area share of temporary crops will likewise increase, while that of perennials decrease; however, tariffication tends to attenuate the changes. Among the temporary crops, by 2030 the area share of palay is still larger than the 2016 area share, even with stronger import competition under tariffication. The increase in area share is 0.5 percent lower under tariffication though than under the baseline.

One may expect palay yields to decline under tariffication. This is not in fact, the case; yields continue to rise over time even with import competition, though at a slower rate than at the baseline (Figure 10). Tariffication introduces only a minimal change in the yield trend for palay; by far the significant changes are to be found for coconut (faster yield growth) and banana (slower yield growth). Such differences must result from second- and higher-order inter-sectoral effects under general equilibrium adjustments.

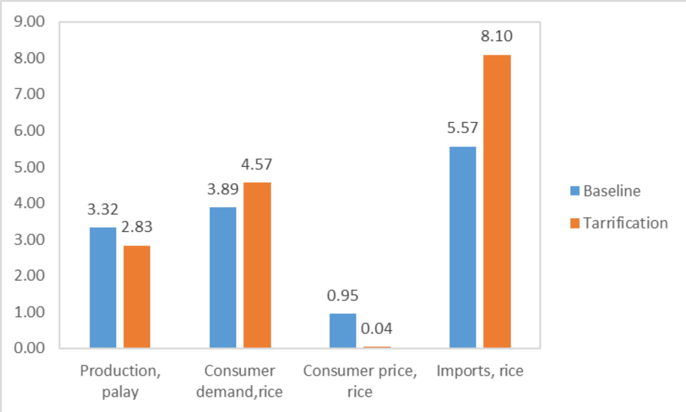
Figure 11 summarizes other differences between average growth projections across scenarios. Consistent with positive growth in yields and area harvested, the tariffication scenario finds a positive average growth for palay production. However, on average it is lower (by 0.49 percentage points) than for the baseline scenario. Growth in consumer demand is however higher for the tariffication scenario, which is directly a result of a slower growth in consumer price of rice. In turn this is due to greater dependence on imports under tariffication; import growth averages a scorching 8.1 percent per year, far higher than the already rapid 5.6 percent page under the baseline scenario.

Figure 10: Percentage difference in yields of major crops, tariffication versus baseline scenario, 2016-2030



Source: Author’s calculation.

Figure 11: Average growth rates of selected variables, baseline and tariffication scenarios, 2016-2030 (%)



Source: Author's calculation.

5. Conclusion

This paper presents a successful application of a CGE model to analyze scenarios covering the SDG period at the level of the Philippine economy and for its agri-food sectors. Unlike previous CGE models, the analysis incorporates endogenous area allocation under an aggregate land constraint.

The baseline scenario finds that growth patterns prevailing since the 2010s can be sustained within the SDG period assuming productivity trends industry and service sectors continue. Unfortunately, the scenario also implies that the mediocre growth performance of agriculture will likewise be sustained into the foreseeable future. Fortunately, agricultural wage keeps pace with wage growth outside of agriculture.

Growth proceeds at a moderate pace for most of the agri-food sectors, with the significant exception of banana, which is expected to contract. Similarly, the major crops are all projected to experience a growth in yield and minor change in area harvested, except for banana where deterioration in both indicators is marked.

The usefulness of the AMPLE-CGE is demonstrated by applying it to a policy experiment, corresponding to one of the largest reform initiatives in Philippine agriculture, namely the tariffication of the rice QR. Tariffication is found to be disadvantageous to the palay sector, based on various indicators, namely area harvested, yield, and production. Even agriculture as a whole is adversely affected, experiencing a further growth slowdown. Nevertheless, overall growth of GDP as well as household per capita expenditure rises with greater openness to rice imports. Consistent with expectation, imports are larger with tariffication, leading to more affordable consumer price of rice, and therefore greater rice demand.

The modeling can be further extended for a richer scenario analysis. Estimation of welfare changes in the form of compensating variation (CV) and equivalent variation (EV) may be quickly added to the repertoire of AMPLE-CGE. A more elaborate development will be to further disaggregate households beyond the urban-rural distinction, namely by quantiles (quintile or even deciles), and finally to incorporate microsimulation analysis for a more straightforward analysis of changes in size distribution of income as well as of poverty.

6. References

Briones, R. 2013. Scenarios and options for productivity growth in Philippine agriculture: An application of the Agricultural Multi-Market Model for Policy Evaluation (AMPLE). SEARCA Monograph Series on Productivity Growth in Philippine Agriculture. SEARCA, DA – BAR, and PhilRice: Los Banos, Laguna, Philippines.

Briones, R., E. Antonio, C. Habito, E. Porio, and D. Songco. 2017. Food Security and Nutrition in the Philippines Strategic Review. World Food Programme and Brain Trust Inc., Pasig City. https://tinyurl.com/ybe8n5pb.

Briones, R. 2017a. Characterization of Agricultural Workers in the Philippines. Discussion Paper Series No. 2017-31. Quezon City: PIDS.

Briones, R. 2017b. Outlook for the Philippine Economy and Agro-Industry to 2030: The Role of Productivity Growth. Discussion Paper Series No. 2017-30. Quezon City: PIDS.

Galang, I. 2017. AMPLE-CGE Model: User Guide. Discussion Paper Series No. 2017-41. Quezon City: PIDS.

PSA. 2016. Decent Work Statistics.

PSA. 2018a. Countrystat. http://countrystat.psa.gov.ph. Accessed November 2018.

PSA. 2018. Population projection statistics. https://psa.gov.ph/statistics/census/projected-population. Accessed November 2018.

World Bank. 2018. Commodity Market Outlook October 2018. World Bank, Washington D.C.