



INTRA-REGIONAL TRADE OUTLOOK USING AN ECONOMY-WIDE MULTIMARKET MODEL

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PAPA Clinics on Regional Trade Analysis
Dakar, May 2-4, 2018

MODEL STRUCTURE AND LOGIC

- FIRST DEVELOPED BY XINSHEN DIAO IN 2006
- AUGMENTED BY ODJO & BADIANE IN 2014 TO ACCOUNT FOR INTRA-REGIONAL TRADE AND THE ANALYSIS OF MAPUTO COMMITMENT ON TRADE
- A REGIONAL MODEL: COUNTRIES ARE TREATED INDIVIDUALLY BUT ALL COUNTRIES ARE RUN TOGETHER
- AVAILABLE FOR EACH OF THREE RECs: COMESA, ECOWAS AND SADC.
- ECONOMY-WIDE MODEL WITH AGRICULTURAL FOCUS. NONAGRICULTURAL SECTOR IS AGGREGATED INTO INDUSTRY AND SERVICES
- ENDOGENOUS PRODUCTION, CONSUMPTION, DOMESTIC AND INTERNATIONAL TRADE DECISIONS
- TRADABLE GOODS: WORLD PRICES ARE EXOGENOUS AND DOMESTIC PRODUCER AND CONSUMER PRICES ARE FUNCTION OF WORLD PRICES WITH EXOGENOUS MARKETING MARGINS
- NON-TRADED GOOD: DOMESTIC PRICES ARE ENDOGENOUSLY DETERMINED BY MARKET CLEARING CONDITION, WITH MARKETING MARGINS
- A DYNAMIC MODEL: GROWTH IN AREA, YIELDS, POPULATION AND NON-AGRICULTURAL INCOME ARE EXOGENOUS
- MODEL IS SOLVED AS A MIXED COMPLEMENTARITY PROBLEM TO ALLOW FOR SHIFT FROM NON-TRADED STATUS TO IMPORTS OR EXPORTS OF THE DIFFERENT COMMODITIES

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MODEL STRUCTURE AND LOGIC (cont'd)

1. Production side

- Yield functions depend on own price
- Area functions depend on all prices
- Supply functions of crops = Yield x Area
- Supply functions of non-crops depend on all prices

2. Demand side

- Demand function for each product depends on all prices and income
- Demand function defined at the country level for rural and urban household groups

3. Imports / exports

- Defined at the country level
- Determined through the links between domestic and import/export parity prices
- Differentiated by intra-regional versus extra-regional origins and sources

4. Price determination

- Defined at the country level
- Equilibrium or disequilibrium between each country's supply and its demand

5. Income

- Defined at the country level by rural and urban household groups
- Determined by both agricultural and nonagricultural production revenues

CONSUMER PRICE INDEX AND FOOD DEMAND

SETS

R	Countries
C	Commodities
H	Household categories

PARAMETERS

$afh_{r c h}$	Food demand intercept
$edfph_{r c h}$	Price elasticity of food demand
$edfih_{r c h}$	Income elasticity of food demand

ENDOGENOUS VARIABLES

CPI_r	Consumer price index
$PD_{r c}$	Domestic producer price
$RQDF_{r c}$	Food demand for country
$RQDFHpc_{r c h}$	p. c. food demand by hhd category
$RQDFH_{r c h}$	Food demand by hhd category
$INC_{r h}$	Total income by hhd category
$POPH_{r h}$	Population by hhd category
$RQDFpc_{r c}$	p. c. food demand for country

- $$CPI_r = \frac{\sum_{c \in C} PD_{r c} \cdot RQDF0_{r c}}{\sum_{c \in C} PD0_{r c} \cdot RQDF0_{r c}}$$
- $$RQDFHpc_{r c h} = afh_{r c h} \cdot \prod_{c' \in C} PD_{r c'}^{edfph_{r c c' h}} \cdot \left(\frac{INC_{r h}}{POPH_{r h}} \right)^{edfih_{r c h}}$$
- $$RQDFH_{r c h} = RQDFHpc_{r c h} \cdot POPH_{r h}$$
- $$RQDF_{r c} = \sum_{h \in H} RQDFH_{r c h}$$
- $$RQDFpc_{r c} = \frac{RQDF_{r c}}{\sum_{h \in H} POPH_{r h}}$$

DEMANDS FOR FEED, SEED, PROCESSED GOOD, WASTE AND OTHER USES

SETS

R	Countries
C	Commodities
$LvLive$	Livestock live animals

PARAMETERS

$IOXL_{r c c'}$	io coef for feed demand
$IOXS_{r c}$	io coef for seed demand
$IOXP_{r c}$	io coef for processed good dem
$IOXW_{r c}$	io coef for waste demand
$ao_{r c}$	intercep in other dem function
$eyp_{r c}$	price elas in other demand fnct
$eyi_{r c}$	income elas in other dem. fnct

ENDOGENOUS VARIABLES

$RQDL_{r c}$	Feed demand for country
$RQX_{r c}$	Total supply by crop for country
$RQDS_{r c}$	Seed demand for country
$RQDP_{r c}$	Processed good demand for r
$RQDW_{r c}$	Waste demand for country
$RQDO_{r c}$	Total other demand incl, manuf
$PX_{r c}$	Domestic producer price
GDP_r	Gross domestic product
$RQDT_{r c}$	Total demand

- $$RQDL_{r c} = \sum_{c' \in LvLive} IOXL_{r c c'} \cdot RQX_{r c'}$$
- $$RQDS_{r c} = IOXS_{r c} \cdot RQX_{r c}$$
- $$RQDP_{r c} = IOXP_{r c} \cdot RQX_{r c}$$
- $$RQDW_{r c} = IOXW_{r c} \cdot RQX_{r c}$$
- $$RQDO_{r c} = ao_{r c} \cdot PX_{r c} \cdot GDP_r^{eyi_{r c}}$$
- $$RQDT_{r c} = RQDF_{r c} + RQDL_{r c} + RQDS_{r c} + RQDP_{r c} + RQDW_{r c} + RQDO_{r c}$$

SUPPLY FOR CROPS WITH AREA CONSTRAINT

SETS

R	Countries
C	Commodities

PARAMETERS

$aa_{r c}$	Intercept in area function
$eap_{r c c'}$	Area own- and cross-price elasticities
$ay_{r c}$	Intercept in yield function
$eyp_{r c}$	Price elasticity in yield function

ENDOGENOUS VARIABLES

$RAC_{r c}$	Total area by crop
$PX_{r c}$	Domestic producer price
$RYC_{r c}$	Yield by crop
$RQX_{r c}$	Total supply by crop for country

- $RAC_{r c} = aa_{r c} \cdot \prod_{c' \in C} PX_{r c'}^{eap_{r c c'}}$

- $RYC_{r c} = ay_{r c} \cdot PX_{r c}^{eyp_{r c}}$

- $RQX_{r c} = RYC_{r c} \cdot RAC_{r c}$

SUPPLY FOR CROPS WITHOUT AREA CONSTRAINT, LIVESTOCK, MEAT, MILK AND PROCESSED OIL

SETS

R	Countries
C	Commodities
$LvLive$	Livestock live animals
$LvMeat$	Livestock meat
$LvMilk$	Livestock milk, skin and eggs
OILSEED	oilseed including cotton
PrOIL	Processed oil

PARAMETERS

$as_{r c}$	Intercept in supply function
$esp_{r c c'}$	Output own- and cross-price elasticities
$IOXX1_{r c c'}$	io coef from live animal to meat
$IOXX2_{r c c'}$	io coef from live animal to milk, skins and eggs
$IOOIL_{r c c'}$	io coef from live animal to milk, skins and eggs

ENDOGENOUS VARIABLES

$RQX_{r c}$	Total supply by crop for country
$PX_{r c}$	Domestic producer price
$RQDO_{r c}$	Total other demand incl, manuf

- $$RQX_{r c} = as_{r c} \cdot \prod_{c' \in C} PX_{r c'}^{esp_{r c c'}}$$

where c is a crop without area constraint
- $$RQX_{r c} = \sum_{c' \in LvLive} IOXX1_{r c' c} \cdot RQDO_{r c'}$$

where $c \in LvMeat$
- $$RQX_{r c} = \sum_{c' \in LvLive} IOXX2_{r c' c} \cdot RQX_{r c'}$$

where $c \in LvMilk$
- $$RQX_{r c} = \sum_{c' \in OILSEED} IOOIL_{r c' c} \cdot RQDO_{r c'}$$

where $c \in PrOil$

INCOME

SETS

R Countries

C Commodities

H Household categories

PARAMETERS

$INCshare_{r c h}$ Share of Income by commodity and hhd

ENDOGENOUS VARIABLES

$PX_{r c}$ Domestic producer price

$RQX_{r c}$ Total supply by crop

$INC_{r h}$ Total income by hhd category

- $GDP_r = \sum_{c \in CGDP} PX_{r c} \cdot RQX_{r c}$

- $INC_{r h} = \sum_{c \in CGDP} INCshare_{r c h} \cdot PX_{r c} \cdot RQX_{r c}$

MARKET CLEARING CONDITIONS

SETS

R Countries
 C Commodities

PARAMETERS

$marginD_{rc}$ Price margin between
consumer and producer
 $marginW_{rc}$ Margin on domestic prices
from or to ROW

ENDOGENOUS VARIABLES

PX_{rc} Domestic producer price
 PD_{rc} Domestic consumer price
 PWE_{rc} World fob price
 RQE_{rc} Volume of net exports
 PWM_{rc} World cif price
 RQM_{rc} Volume of net imports
 RQX_{rc} Total supply by crop
 $RQDT_{rc}$ Total demand

- $PX_{rc} \cdot (1 + marginD_{rc}) = PD_{rc}$

Complementarity relationships

- $PX_{rc} \geq PWE_{rc} \cdot (1 - marginW_{rc})$ and
 $RQE_{rc} \geq 0$

- $PWM_{rc} \cdot (1 + marginW_{rc}) \geq PD_{rc}$ and
 $RQM_{rc} \geq 0$

- $RQX_{rc} + RQM_{rc} - RQE_{rc} = RQDT_{rc}$

TRADE FLOWS DIFFERENTIATION BY SOURCES AND DESTINATIONS

SETS

- R Countries
- C Commodities

PARAMETERS

- $\rho_{rc}^e, \delta_{rc}^e$ and α_{rc}^e CET function exponent, share parameter and shift parameter, respectively
- $\rho_{rc}^m, \delta_{rc}^m$ and α_{rc}^m CES function exponent, share parameter and shift parameter, respectively

ENDOGENOUS VARIABLES

- RQE_{rc} Aggregate volume of net exports
- $RRQE_{rc}$ Volume of exports to intra-regional market outlets
- $RWQE_{rc}$ Volume of exports to extra-regional market outlets
- RQM_{rc} Composite volume of net imports
- $RRQM_{rc}$ Volume of net imports from intra-regional sources
- $RWQM_{rc}$ Volume of imports from extra-regional sources
- PX_{rc} Composite domestic producer price
- PER_{rc} Domestic producer price of intra-regional sales
- PEZ_{rc} Domestic producer price of extra-regional sales
- PD_{rc} Composite domestic consumer price
- PMR_{rc} Domestic consumer price of intra-regional varieties
- PMZ_{rc} Domestic consumer price of extra-regional varieties

Imperfect transformation between intra-regional and extra-regional export destinations

- $$RQE_{rc} = \alpha_{rc}^e \cdot \left(\delta_{rc}^e \cdot RRQE_{rc}^{\rho_{rc}^e} + (1 - \delta_{rc}^e) \cdot RWQE_{rc}^{\rho_{rc}^e} \right)^{\frac{1}{\rho_{rc}^e}}$$
- $$\frac{RRQE_{rc}}{RWQE_{rc}} = \left(\frac{PER_{rc}}{PEZ_{rc}} \cdot \frac{1 - \delta_{rc}^e}{\delta_{rc}^e} \right)^{\frac{1}{\rho_{rc}^e - 1}}$$
- $$PE_{rc} \cdot RQE_{rc} = PER_{rc} \cdot RRQE_{rc} + PEZ_{rc} \cdot RWQE_{rc}$$
- $$PER_{rc} = PEZ_{rc} = PX_{rc}$$

Imperfect substitution between intra-regional and extra-regional import sources

- $$RQM_{rc} = \alpha_{rc}^m \cdot \left(\delta_{rc}^m \cdot RRQM_{rc}^{-\rho_{rc}^m} + (1 - \delta_{rc}^m) \cdot RWQM_{rc}^{-\rho_{rc}^m} \right)^{-\frac{1}{\rho_{rc}^m}}$$
- $$\frac{RRQM_{rc}}{RWQM_{rc}} = \left(\frac{PMZ_{rc}}{PMR_{rc}} \cdot \frac{\delta_{rc}^m}{1 - \delta_{rc}^m} \right)^{\frac{1}{1 + \rho_{rc}^m}}$$
- $$PM_{rc} \cdot RQM_{rc} = PMR_{rc} \cdot RRQM_{rc} + PMZ_{rc} \cdot RWQM_{rc}$$
- $$PMR_{rc} = PMZ_{rc} = PD_{rc}$$

HANDS-ON SESSION

- FAMILIARIZING WITH MODEL'S GAMS CODES
- DESIGNING AND IMPLEMENTING SIMULATION SCENARIOS
- RESULTS REPORTING

THANKS FOR YOUR ATTENTION