



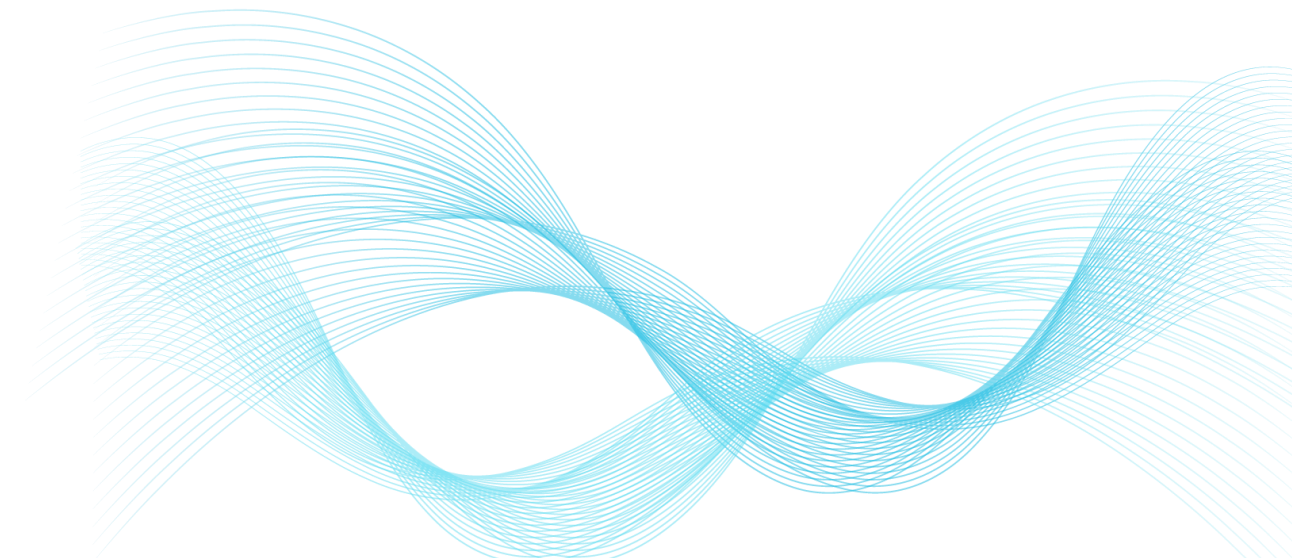
UNITED NATIONS

الاسكوا  
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WELCOME  
Session 15

# Model EXTER

AN OPEN ECONOMY WITH OPEN GOVERNMENT



# Hypotheses

Model

- Open Economy
- Open Government

Industries/Commodities

- Agriculture
- Manufacturing
- Services
- Public Administration

Factors of Production

- Labor (mobile across sectors)
- Capital (fixed by sector)

Categories of Households

- Salary Households
- Capitalists

# Sets

## Industries and commodities

- $i, j \in I = \{AGR, MAN, SER, PUB\}$   
(AGR=agriculture, MAN: manufacturing, SER: services, PUB: public administrations)
- Tradable commodities and industries  
(excluding public administrations)  
 $tr \in TR \subset I = \{AGR, MAN, SER\}$   
(AGR: agriculture, MAN: manufacturing, SER: service)
- Sub-set of tradable industries and commodities, excluding services:  
 $bns \in BNS \subset TR = \{AGR, MAN\}$

## Households

$h \in H = \{SAL, CAP\}$   
(SAL: salaried, CAP: capitalists)

# Equations

## Production

$$1. VA_j = v_j \cdot XS_j$$

$$2. CI_j = io_j \cdot XS_j$$

$$3. VA_{tr} = A_{tr} \cdot LD_{tr}^{\alpha_{tr}} \cdot KD_{tr}^{1-\alpha_{tr}}$$

$$4. LD_{tr} = \frac{\alpha_{tr} \cdot PVA_{tr} \cdot VA_{tr}}{W}$$

$$5. KD_{tr} = \frac{(1 - \alpha_{tr}) \cdot PVA_{tr} \cdot VA_{tr}}{R_{tr}}$$

$$6. LD_{I_{PUB'}} = VA_{I_{PUB'}}$$

$$7. DI_{tr,j} = a_{ij_{tr,j}} \cdot CI_j$$

## Income & savings (1)

$$8. YH_{SAL} = W \cdot \sum_j LD_j + TG$$

$$9. YH_{CAP} = \lambda \sum_{tr} R_{tr} \cdot KD_{tr} + DIV$$

$$10. YDH_h = YH_h - DTH_h$$

$$11. SH_h = \psi_h \cdot YDH_h$$

$$12. CTH_h = YDH_h - SH_h$$

$$13. YF = (1 - \lambda - \lambda^R) \cdot \sum_{tr} R_{tr} \cdot KD_{tr}$$

$$14. SF = YF - DIV - DIV^R - DTF$$

## Income & Savings (2)

$$15. YG = \sum_{tr} \{ TI_{tr} + TIM_{tr} + TIE_{tr} \} + \sum_h DTH_h + DTF$$

$$16. TI_{tr} = tx_{tr} \cdot \{ PL_{tr} \cdot DD_{tr} + (1 + tm_{tr}) \cdot e \cdot PWM_{tr} \cdot IM_{tr} \}$$

$$17. TIM_{tr} = tm_{tr} \cdot e \cdot PWM_{tr} \cdot IM_{tr}$$

$$18. TIE_{tr} = te_{tr} \cdot PE_{tr} \cdot EX_{tr}$$

$$19. DTH_h = tyh_h \cdot YH_h$$

$$20. DTF = tyf \cdot YF$$

$$21. SG = YG - G - TG$$

## Demand

$$22. C_{tr,h} = \frac{\gamma_{tr,h} CYH_h}{PC_{tr}}$$

$$23. INV_{tr} = \frac{\mu_{tr} IT}{PC_{tr}}$$

$$24. DIT_{tr} = \sum_j DI_{tr,j}$$



## International Trade (1)

$$25. X S_{tr} A_{tr}^E \left[ \beta_{tr}^E \cdot EX_{tr}^{\rho_{tr}^E} + (1 - \beta_{tr}^E) \cdot DS_{tr}^{\rho_{tr}^E} \right]^{\frac{1}{\rho_{tr}^E}}$$

$$26. \frac{EX_{tr}}{DS_{tr}} = \left[ \left( \frac{PE_{tr}}{PL_{tr}} \right) \cdot \left( \frac{1 - \beta_{tr}^E}{\beta_{tr}^E} \right) \right]^{\sigma_{tr}^E}$$

$$27. Q_{tr} = A_{tr}^M \left[ \beta_{tr}^M \cdot IM_{tr}^{-\rho_{tr}^M} + (1 - \beta_{tr}^M) \cdot DD_{tr}^{-\rho_{tr}^M} \right]^{\frac{-1}{\rho_{tr}^M}}$$

## International Trade (2)

$$28. \frac{IM_{tr}}{DD_{tr}} = \left[ \left( \frac{PD_{tr}}{PM_{tr}} \right) \cdot \left( \frac{\beta_{tr}^M}{1 - \beta_{tr}^M} \right) \right]^{\sigma_{tr}^M}$$

$$29. CAB = e \sum_{tr} PWE_{tr} \cdot EX_{tr} - e \sum_{tr} PWM_{tr} \cdot IM_{tr} - \lambda^R \sum_{tr} R_{tr} \cdot KD_{tr} - DIV^R$$

## Verification of the walras' law

$$45.LEON = Q_{SER} - \sum_h C_{h,SER} - DIT_{SER} - DIT_{SER} - INV_{SER}$$

# Variables

## Volume Variables (quantities) (1)

$C_{tr,h}$  : Consumption of commodity tr by type h household

$CI_j$  : Total intermediate consumption of industry j

$DD_{tr}$  : Demand for domestic commodity tr

$DIT_{tr}$  : Total intermediate demand for commodity tr

$DS_{tr}$  : Supply of commodity tr on the local market

$EX_{tr}$  : Exports of commodity tr

$IM_{tr}$  : Imports of commodity tr

## Volume Variables (quantities)(2)

$INV_{tr}$  : Final demand of commodity tr for investment purposes

$KD_{tr}$  : Industry tr demand for capital

$KS_{tr}$  : Capital supply in industry tr

$LD_j$  : Industry demand for labor

LS : Total labor supply

$Q_{tr}$  : Demand for composite commodity tr

$VA_j$  : Value added of industry j

$XS_j$  : Output of industry j

## Prices (1)

$e$  : Nominal exchange rate

$P_j$  : Price of industry  $j$  output

$PC_{tr}$  : Purchase price of composite commodity  $l$

$PCI_j$  : Intermediate consumption price index of industry  $j$

$PD_{tr}$  : Price of commodity  $tr$  sold on the local market (including taxes)

$PE_{tr}$  : Producer price of exported commodity  $tr$

PINDEX : Price index (GDP deflator)

## Prices (2)

$PL_{tr}$  : Price of commodity  $tr$  sold on the local market (excluding taxes)

$PM_{tr}$  : Price of imported commodity  $tr$  (including duties and taxes)

$PVA_j$  : Price of industry  $j$  value added

$PWE_{tr}$  : World price of exported product  $tr$  (in foreign currency)

$PWM_{tr}$  : World price of imported product  $tr$  (in foreign currency)

$R_{tr}$  : Rental rate of capital in industry  $tr$

$W$  : Wage rate

## Nominal Variables (values) (1)

CAB : Current account balance

$CTH_h$  : Consumption budget of type h households

DIV : Dividends paid to households

$DIV^R$  : Dividends paid to foreigners

DTF : Receipts from direct taxation of firms' income

$DTH_h$  : Receipts from direct taxation on household h income

G : Current public expenditure

IT : Total investment

SF : Business savings

SG : Government savings



## Nominal Variables (values)(2)

$SH_h$  : Savings of type h household

TG : Public transfers to salaried households

$TI_{tr}$  : Receipts from indirect tax on commodity tr

$TIE_{tr}$  : Receipts from indirect tax on exported commodity tr

$TIM_{tr}$  : Receipts from import duties on commodity tr

$YDH_h$  : Disposable income of type h households

YF: Business income

YG : Government income

$YH_h$  : Income of type h household

## Other variables

LEON : Excess supply on the market for services

## Exogenous Variables (closures)

CAB : Current account balance

DIV : Dividends paid to households

$DIV^R$  : Dividends paid to foreigners

e : Nominal exchange rate

$KS_{tr}$  : Capital supply in industry

LS : total labor supply

$PWE_{tr}$  : World price of exported product tr (in foreign currency)

$PWM_{tr}$  : World price of imported product tr (in foreign currency)

TG : Public transfers to salaried household

# Parameters (1)

$A_{tr}$  : Scale parameter (Cobb-Douglas – production function)

$A_{tr}^E$  : Scale parameter (CET- supply function)

$A_{tr}^M$  : Scale parameter (CES – demand function)

$aij_{tr,j}$  : Coefficient ( Leontief – intermediate consumption)

$\alpha_{tr}$  : Elasticity (Cobb Douglas – production function)

$\beta_{tr}^E$  : Distribution parameter (CET – supply function)

$\beta_{tr}^M$  : Distribution parameter (CES – demand function )

(2)

$\gamma_{tr,h}$  : Share of commodity  $tr$  in type  $h$  household consumption budget

$i_{0j}$  : Coefficient (Leontief – total intermediate consumption)

$\lambda$  : Share of capital income received by capitalists

$\lambda^R$  : Share of capital income received by foreigners

$\mu_{tr}$  : Share of commodity  $tr$  in total investment expenditures

$\psi_h$  : Average propensity to save of type  $h$  household

$\rho_{tr}^E$  : Elasticity parameter (CET – supply function)

(3)

$\rho_{tr}^M$  : Elasticity parameters (CES – demand function)

$\sigma_{tr}^E$  : Elasticity (CET – supply function)

$\sigma_{tr}^M$  : Elasticity (CES – demand function)

$te_{tr}$  : Tax rate on exported commodity tr

$tm_{tr}$  : Rate of duties on imported commodity tr

$tx_{tr}$  : Indirect tax rate on commodity tr

$tyf$  : Direct tax rate on firm's income

$tyh_h$  : Direct tax rate on household h income

$v_j$  : Coefficient (Leontief – value added)

# Social Accounting Matrix for EXTER

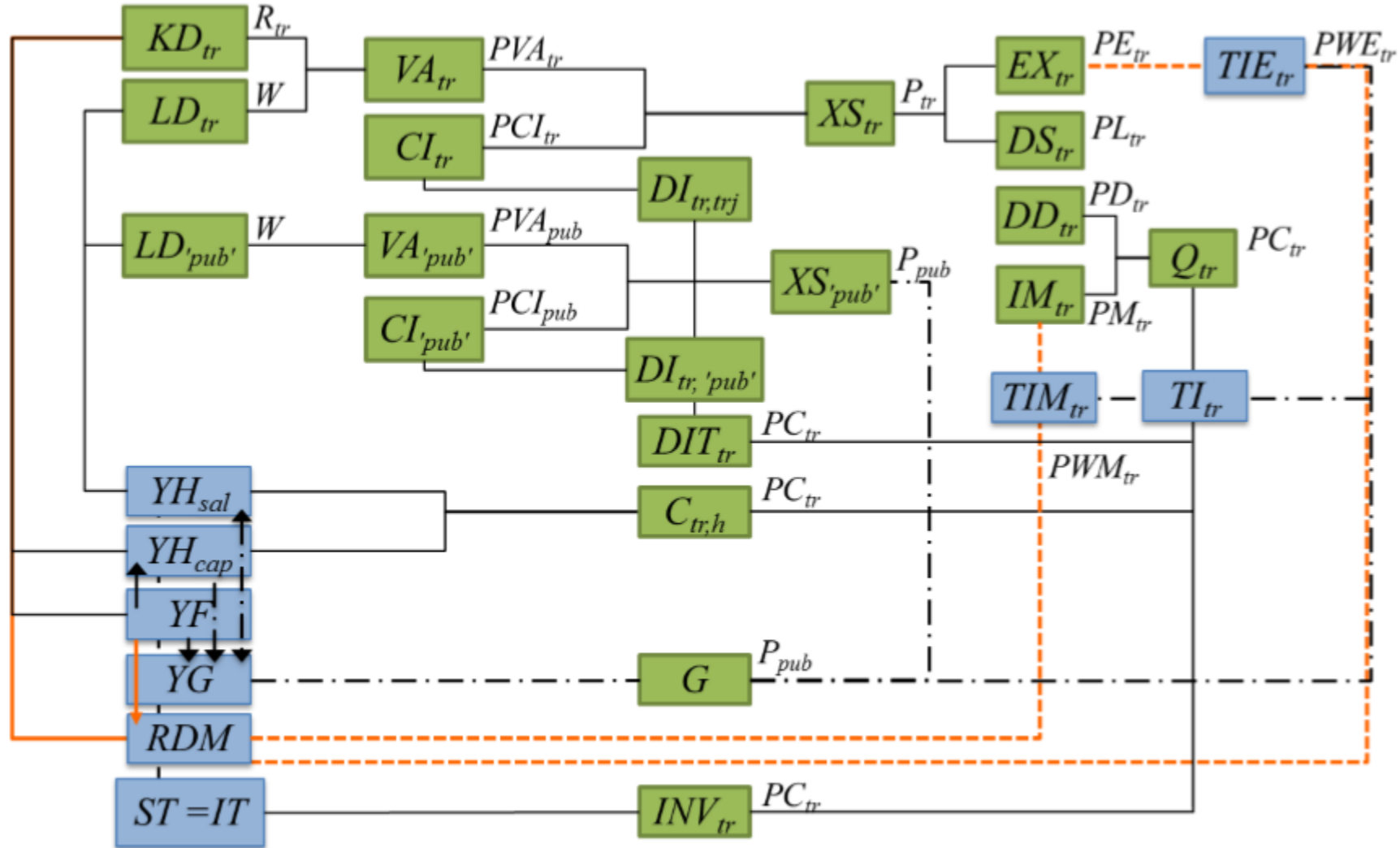
	FACTORS		AGENTS					INDUSTRIE				COMMODITIES (LOCAL MARKET)				COMMODITIES (WORLD MARKET)			ACC	TOTAL		
	1.	2.	3.	4.	5.	6.	6a.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	(1 to 19)	
1. Labour									300	100	200	150									750	
2. Capital									100	150	100										350	
3. Salaried households	750					50															800	
4. Capitalists		210			70																280	
5. Firms		105																			105	
6. Government			40	28	7		82						8	10	13		20				208	
6a. Duties													2	78	2						82	
7. Rest of the world		35			8								50	780	5						878	
8. Agriculture													310				190				500	
9. Manufacturing														520				105			625	
10. Services															565				35		600	
11. Public admin.																200					200	
12. Agriculture			90	10					20	75	60	10									105	370
13. Manufacturing			180	110					50	225	135	25									663	1388
14. Services			270	90					30	75	105	15									585	
15. Public admin.						200															200	
16. Agriculture								210													210	
17. Manufacturing								105													105	
18. Services								35													35	
19. Accumulation			220	42	20	-42		528													768	
Total (1 to 19)	750	350	800	280	105	208	82	878	500	625	600	200	370	1388	585	200	210	105	35	768		

# Link between SAM & the Model

	FACTORS		AGENTS					INDUSTRIES				COMMODITIES (LOCAL MARKET)				COMMODITIES (WORLD MARKET)			ACC	TOTAL
	1.	2.	3.	4.	5.	6.	6a.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	$W \times \sum_j LD_j$	(1 to 19)
1. Labour	$W \times \sum_j LD_j$							$W \times LD_j$	300	100	200	150							$W \times \sum_j LD_j$	750
2. Capital		$\lambda \sum R_v KD_v$							100	150	100		$R_v \times KD_v$					$\sum R_v \times KD_v$	350	
3. Salaried households	750							$DIV$											$YH_h$	800
4. Capital								50					$TG$							280
5. Factor	$(1 - \lambda - \lambda^R) \sum R_v KD_v$	210						70					$TI_v$						$YF$	105
6. Government																			$YG$	208
6a. Duties																				82
7. Rest of the													$TIM_v$							82
8. Agriculture																				500
9. Manufacturing	$\lambda^R \sum R_v KD_v$	35																		625
10. Services																				600
11. Public admin.																				200
12. Agriculture																				370
13. Manufacturing																				1388
14. Services																				585
15. Public admin.																				200
16. Agriculture																				210
17. Manufacturing	$W \times \sum_j LD_j$	$\sum R_v \times KD_v$																		105
18. Services																				35
19. Accumulation																				768
Total (1 to 19)	750	350	800	280	105	208	82	878	500	625	600	200	370	1388	585	200	210	105	35	768

$W \times \sum_j LD_j$  (Factors 1, 17)  
 $\lambda \sum R_v KD_v$  (Factor 2)  
 $(1 - \lambda - \lambda^R) \sum R_v KD_v$  (Factor 5)  
 $\lambda^R \sum R_v KD_v$  (Factor 8)  
 $W \times LD_j$  (Agents 1, 3, 4)  
 $DIV$  (Agents 3, 4)  
 $TG$  (Agents 4, 5)  
 $DTF$  (Agents 5, 6)  
 $\sum TIM_v$  (Agents 5, 6, 7)  
 $DTH_h$  (Agents 6, 7)  
 $DIV^R$  (Agents 7, 8)  
 $PC_v \times DI_{v,j}$  (Agents 7, 12-15)  
 $PC_v \times C_{v,h}$  (Agents 7, 12-15)  
 $G$  (Agents 7, 15)  
 $e \times PWE_v \times EX_v$  (Agents 16-18)  
 $-CAB$  (Agents 17, 18)  
 $P_j \times XS_j$  (Agents 17, 18)  
 $PC_v \times Q_v$  (Agents 17, 18)  
 $W \times \sum_j LD_j$  (Agents 17, 19)  
 $\sum R_v \times KD_v$  (Agents 17, 19)  
 $SH_h$  (Agents 17, 18)  
 $SF$  (Agents 17, 18)  
 $SG$  (Agents 17, 18)  
 $YH_h$  (Agents 3, 17)  
 $YF$  (Agents 5, 17)  
 $YG$  (Agents 6, 17)  
 $R_v \times KD_v$  (Agents 2, 12)  
 $TI_v$  (Agents 4, 12)  
 $TIE_v$  (Agents 4, 16)  
 $YH_h$  (Agents 4, 17)  
 $YF$  (Agents 5, 17)  
 $YG$  (Agents 6, 17)  
 $PE_v \times EX_v$  (Agents 12, 16)  
 $P_j \times XS_j$  (Agents 12, 17)  
 $PC_v \times INV_v$  (Agents 12, 16)  
 $PC_v \times Q_v$  (Agents 12, 16)  
 $P_{PUB'} \times XS_{PUB'}$  (Agents 12, 16)  
 $e \times PWE_v \times EX_v$  (Agents 16, 18)  
 $IT$  (Agents 18, 19)

# Schematic Representation





Thank  
you.