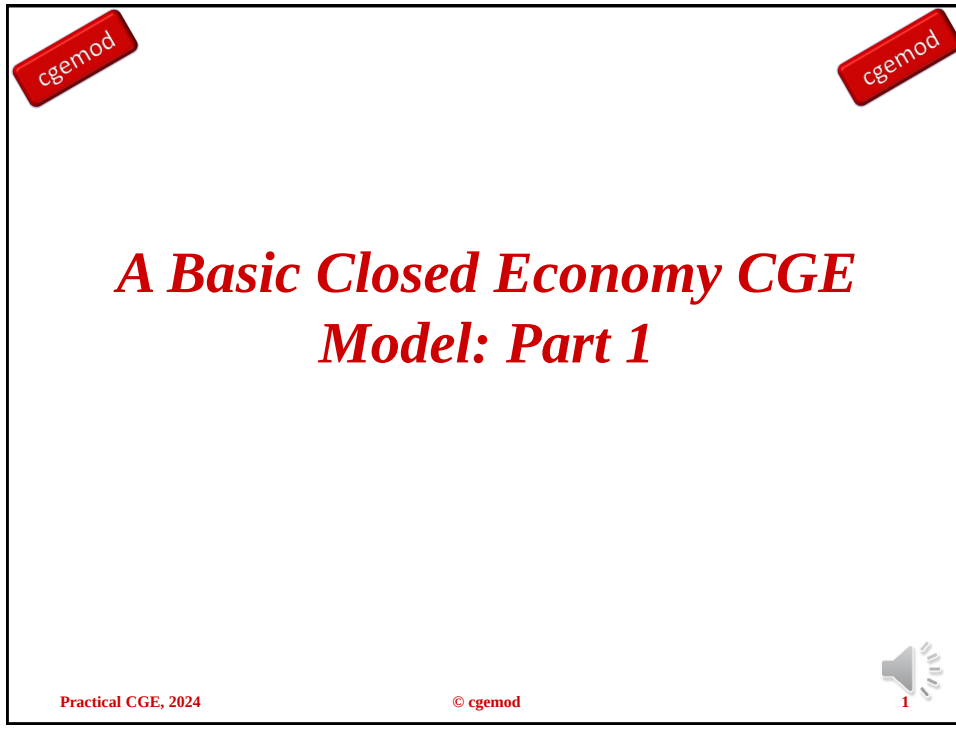
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A Basic Closed Economy CGE Model: Part 1
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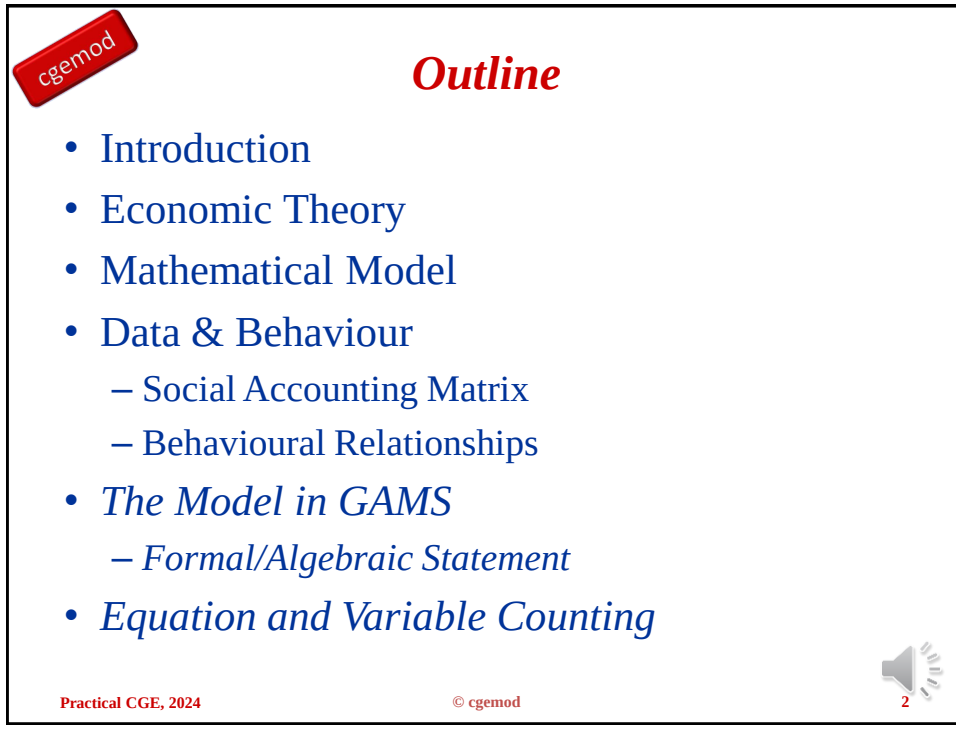
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Outline
• Introduction
• Economic Theory
• Mathematical Model
• Data & Behaviour
– Social Accounting Matrix
– Behavioural Relationships
• The Model in GAMS
– Formal/Algebraic Statement
• Equation and Variable Counting
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2

Aims

- The development of an appreciation of the processes involved when moving from a theoretical to an applied model.
- The development of an understanding of the structure of CGE models.
- The development of generic (GAMS) programming skills.
- An introduction to model calibration.

3

Closed Economy General Equilibrium

- 2*(2*)2*2 Model
  - Standard model from intermediate microeconomics
  - Isoquants/Indifference curves/Edgeworth boxes
- Agents
  - 2 commodities (products)
  - 2 activities (industries)
  - 2 factors
  - 2 households
- No government – no taxes
- No savings/investment – no time dimension
- No trade

Ceteris paribus condition in PE theories presumes that the GE effects are sufficiently small as to justify 'discounting'

4

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Economic Theory

5

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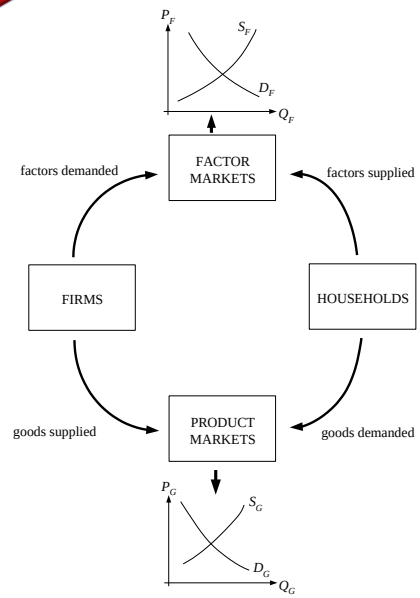
GE & Circular Flow



- Excluded
  - Trade
  - Intermediate inputs
  - Taxes
  - Savings/investment
- Assumptions
  - Perfect knowledge
  - Full information
  - Perfect competition
  - Perfect factor mobility
  - Homogenous products
  - Free entry/exit

6

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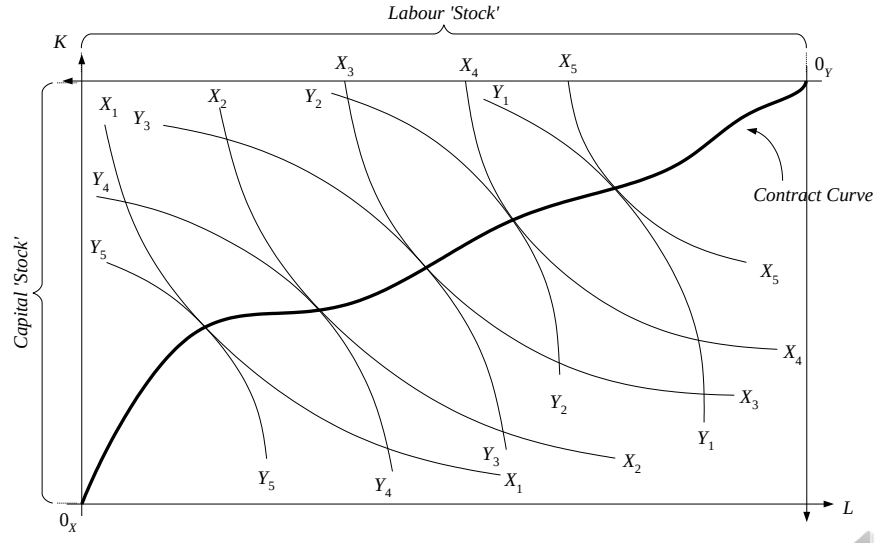
Efficiency in Production



7

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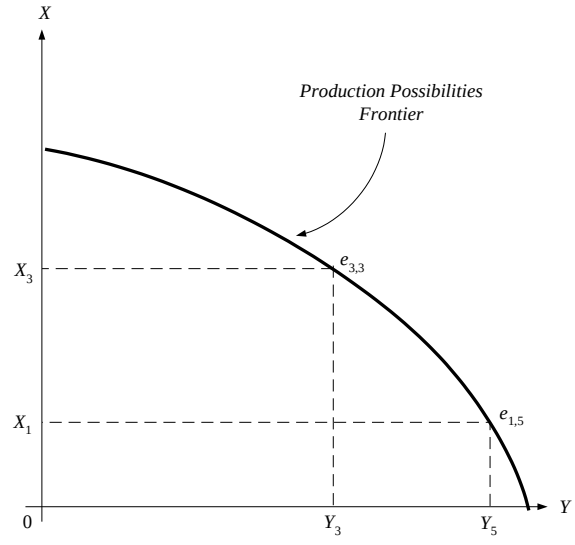
Production Possibilities Frontier



8

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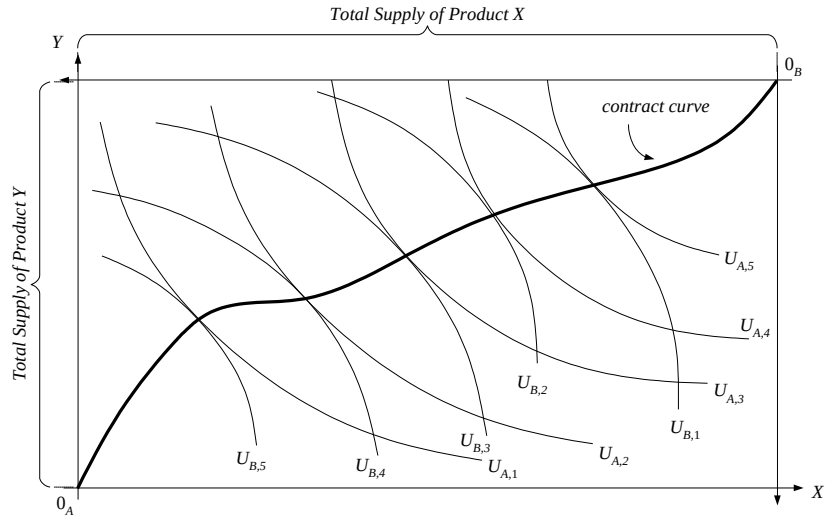
Efficiency in Exchange



9

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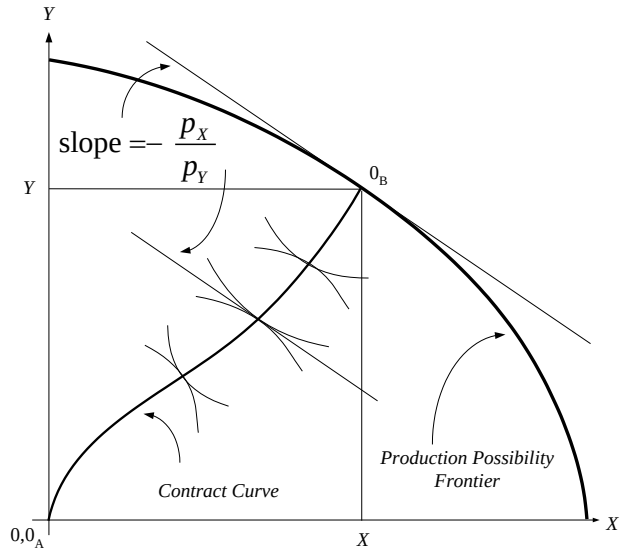
General Equilibrium



10

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Prices for Products and Factors

$$MRTS^{x}_{LK} = MRTS^{y}_{LK} = \frac{w}{r} = MRTS_{LK}$$ Profit max requires

$$MRS^{A}_{XY} = MRS^{B}_{XY} = \frac{p_X}{p_Y}$$ Utility max requires

$$w = MPP^{X}_{L}.p_X = MPP^{Y}_{L}.p_Y$$
$$r = MPP^{X}_{K}.p_X = MPP^{Y}_{K}.p_Y$$
Optimal factor use requires

11

Prices for Products and Factors

$$\frac{w}{r} = \frac{MPP^{X}_{L}.p_X}{MPP^{X}_{K}.p_X} = \frac{MPP^{Y}_{L}.p_Y}{MPP^{Y}_{K}.p_Y} = MRTS_{L,K}$$

Letting $p_x = 1$

$$\frac{r}{p_X} = \left(MPP_X\right)$$
$$\frac{w}{p_X} = \left(MPP^{X}_{K}\right).\left(MRTS_{LK}\right)$$
$$\frac{p_Y}{p_X} = \left(MRS_{YX}\right)$$

a numéraire

12

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Income Distribution

$$p_X.X + p_Y.Y = w.\bar{L} + r.\bar{K}$$

Total system income equals total system expenditure

$$p_X.X_A + p_Y.Y_A = w.\bar{L}_A + r.\bar{K}_A$$
$$p_X.X_B + p_Y.Y_B = w.\bar{L}_B + r.\bar{K}_B$$

Total household income equals total household expenditure

Not independent by product exhaustion theorem

$$\bar{L} = L_A + L_B$$
$$\bar{K} = K_A + K_B$$

Full employment

Different distributions of resources lead to different product combinations & therefore to different GE solutions

→ ***welfare economics***

13

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Mathematical Model

14

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Society's Programming Problem

$$\max_{X,Y} W = W\left(u^A, u^B\right)$$

subject to

$X = X^A + X^B = x\left(L^x, K^x\right)$ $Y = Y^A + Y^B = y\left(L^Y, K^Y\right)$ technology

$u^A = u^A\left(X^A, Y^A\right)$ $u^B = u^B\left(X^B, Y^B\right)$ preferences

$\bar{L} = L^x + L^y$ $\bar{K} = K^x + K^y$ factor endowments

An optimisation problem

A system of simultaneous equations

15

Functional Forms

$$X = \alpha_x L_x^{\beta_1} K_x^{\beta_2}$$

$$Y = \alpha_y L_y^{\beta_3} K_y^{\beta_4}$$

Technology expressed as production functions

Non linear

$$U_a = \alpha_a X_a^{\gamma_1} Y_a^{\gamma_2}$$

$$U_b = \alpha_b X_b^{\gamma_3} Y_b^{\gamma_4}$$

Preferences expressed as utility functions

$$\bar{L} = L_A + L_B$$

$$\bar{K} = K_A + K_B$$

Endowments ← **Linear**

16

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Economic Data

17

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Social Accounting Matrix

		Commodities		Activities		Factors		Households		
		Primary	Secondary	Agriculture	Industry	Labour	Capital	Urban	Rural	Total
Commodities	Primary							50	75	125
	Secondary							100	50	150
Activities	Agriculture	125								125
	Industry		150							150
Factors	Labour			62	55					117
	Capital			63	95					158
Households	Urban					60	90			150
	Rural					57	68			125
Total		125	150	125	150	117	158	150	125	

18

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Behaviour and Labels

19

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Behavioural Relationships

	Commodities	Activities	Factors	Households	Total	Prices
Commodities	0	0	0	Cobb-Douglas Utility Functions	Commodity Demand	Commodity Prices
Activities	Cobb-Douglas Production Functions	0	0	0	Activity Output	Activity Prices
Factors	0	Factor Demand Functions	0	0	Factor Income	Factor Prices
Households	0	0	Fixed Shares of Factor Income	0	Household Income	
Total	Commodity Supply	Activity Input	Factor Expenditure	Household Expenditure		

20

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SAM Transactions Labels

		Commodities		Activities		Factors		Households	
		Primary	Secondary	Agriculture	Industry	Labour	Capital	Urban	Rural
Commodities	Primary	0	0	0	0	0	0	$PQD_c * QCD_{c,h}$	
	Secondary	0	0	0	0	0	0		
Activities	Agriculture	$PX_a * QX_a$		0	0	0	0	0	0
	Industry			0	0	0	0	0	0
Factors	Labour	0	0	$WF_f * FD_{f,a}$		0	0	0	0
	Capital	0	0			0	0	0	0
Households	Urban	0	0	0	0	$hvash_{h,f} * YF_f$		0	0
	Rural	0	0	0	0			0	0

21

The End

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22