

# Modeling Methodology

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# Outline

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Introduction

Households

- Consumers

- Labor Market

Producers

- Technology

- Industry Structure

- Investment and Capital

International and Interregional Trade

Government

Environment

# Basic and Advanced Models

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## ▶ Basic Model

- ▶ statics
- ▶ homogeneous households
- ▶ perfect competition
- ▶ straightforward labor supply

## ▶ Advanced Model

- ▶ fully rational perfect-foresight dynamics
- ▶ heterogeneous households (according to income?)
- ▶ some industries: monopolistic competition
- ▶ allowing labor migration
- ▶ search on the job market

## Consumers: Basic Model

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Maximizing LES function:

$$\max_{C_1, \dots, C_I} \sum_i \alpha_i \ln(C_i - \mu_i)$$

subject to

$$P_1 C_1 + \dots + P_I C_I \leq \text{CBUD}.$$

Here  $C_1, \dots, C_I$  are the consumed amounts of Armington composites of the corresponding goods.

Consumption expenditure:

$$\text{CBUD} = \left( Y(1 - t_y) + \text{TRF} + \text{UNEMPB} \right) (1 - \text{mps}).$$

## Consumers: Advanced Model

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$$\max_{(C_{it})_{it}} \sum_{t=0}^T \beta^t \sum_i \alpha_i \ln(C_{it} - \mu_i)$$

subject to

$$\sum_{t=0}^T D_t \sum_{i=1}^I P_{it} C_{it} \leq \sum_{t=0}^T D_t (Y_t(1 - ty_t) + \text{TRF}_t + \text{UNEMPB}_t),$$

where discount factors  $D_t$  are given by the inverse of compound interest rates:

$$D_t = \prod_{\tau=1}^t \frac{1}{1 + \text{RK}_{\tau}}.$$

## Labor Market

- ▶ Labor supply  $LS_{rt}$  in region  $r$  in time period  $t$ :

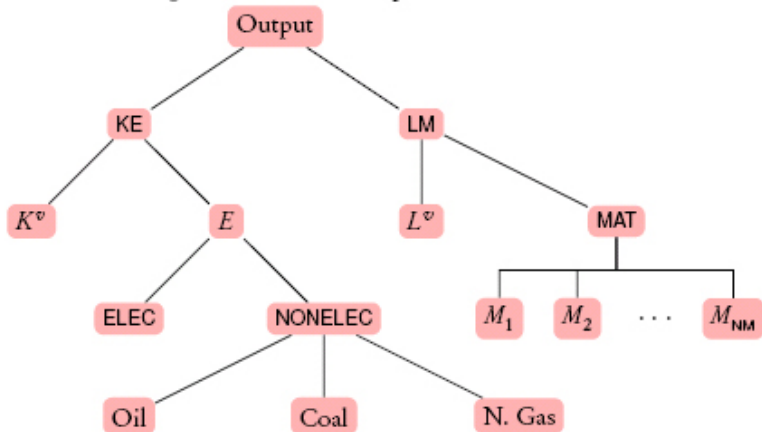
$$LS_{rt} = LS_{rt-1} + \sum_{r'=1}^R \text{migr}_{r'r} \cdot LS_{r't-1}.$$

- ▶ Probability QR of a vacancy filling depending on the number of vacancies NV and the unemployment level UNEMP:

$$QR = a^m NV^{\alpha^m - 1} UNEMP^{1 - \alpha^m}.$$

- ▶ In equilibrium:  $QR \cdot NV = L - L_{-1}(1 - jd)$ .

# Technology



## Monopolistic Competition

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- ▶ Consumed good is a composite of a large number of individual goods:

$$C = \left( \sum_{k=1}^{NF} (c_k)^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$$

- ▶ Prices of individual goods  $p_k$ , the price of the composite  $P$  and the (marginal) cost of the firm  $COST_k$ :

$$p_k = P \cdot NF^{\frac{1}{\sigma-1}} \quad p_k = \frac{\sigma}{\sigma-1} COST_k.$$

- ▶ Zero-profit condition:  $P \cdot C = \sigma(PW \cdot L^f + K^f)$ .

## Investment and Capital

- ▶ Special investment sector with CES production function (intermediate goods → investment good).
- ▶ Investment in basic model

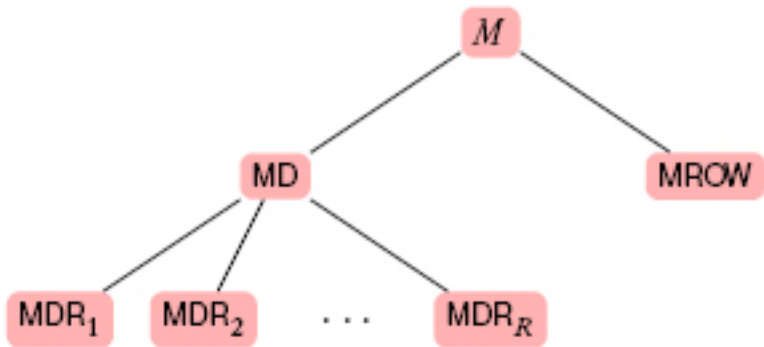
$$I = SH + SG + SROW \cdot ER.$$

- ▶ In advanced model:
  - ▶ Capital accumulation:  $K_t = K_{t-1} - \delta K_{t-1} + I.$
  - ▶ Adjustment costs:

$$A^{\text{adj}} \left( \frac{I}{K} \right)^{\alpha^{\text{adj}}} K \cdot \text{ces}_{1/\sigma^{\text{inv}}; a_1^{\text{inv}}, \dots, a_{\text{NIM}}^{\text{inv}}} (\text{PM}_1, \dots, \text{PM}_{\text{NIM}}).$$

# Armington Structure

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## Government

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- ▶ Two levels: federal and regional
- ▶ Government consumption budget:

$$\text{CBUDGOV} = \text{TAXRG} + \text{TRFGY} + \text{TRFROW} \cdot \text{ER} \\ - \text{SUBSG} - \text{UNEMPB} - \text{TRFF} - \text{TRFGE} - \text{SG}.$$

- ▶ Fixed transfer rates

## Environment

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**Emission accounting** emission levels of pollutant  $p$  in sector  $s$ , corresponding to the combustion of the fuel input  $i$  are given by

$$ef_{p,s,i} \cdot \mu_i \cdot x_i, \quad (1)$$

where  $x_i$  is the amount of the input;  $ef_{p,s,i}$  emission factors;  $\mu_i$  energy content coefficients

**Pollution abatement** none

**Environmental feedback** none

## Conclusion

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- ▶ Relatively simple basic static model
- ▶ Ambitious advanced model:
  - ▶ full rationality in dynamics
  - ▶ adjustment costs in investment sector
- ▶ The simplest approach to modeling environment
- ▶ Conventional approach in incorporating trade and modeling technological and consumption structures
- ▶ Attempt at modeling labor migration and job market search