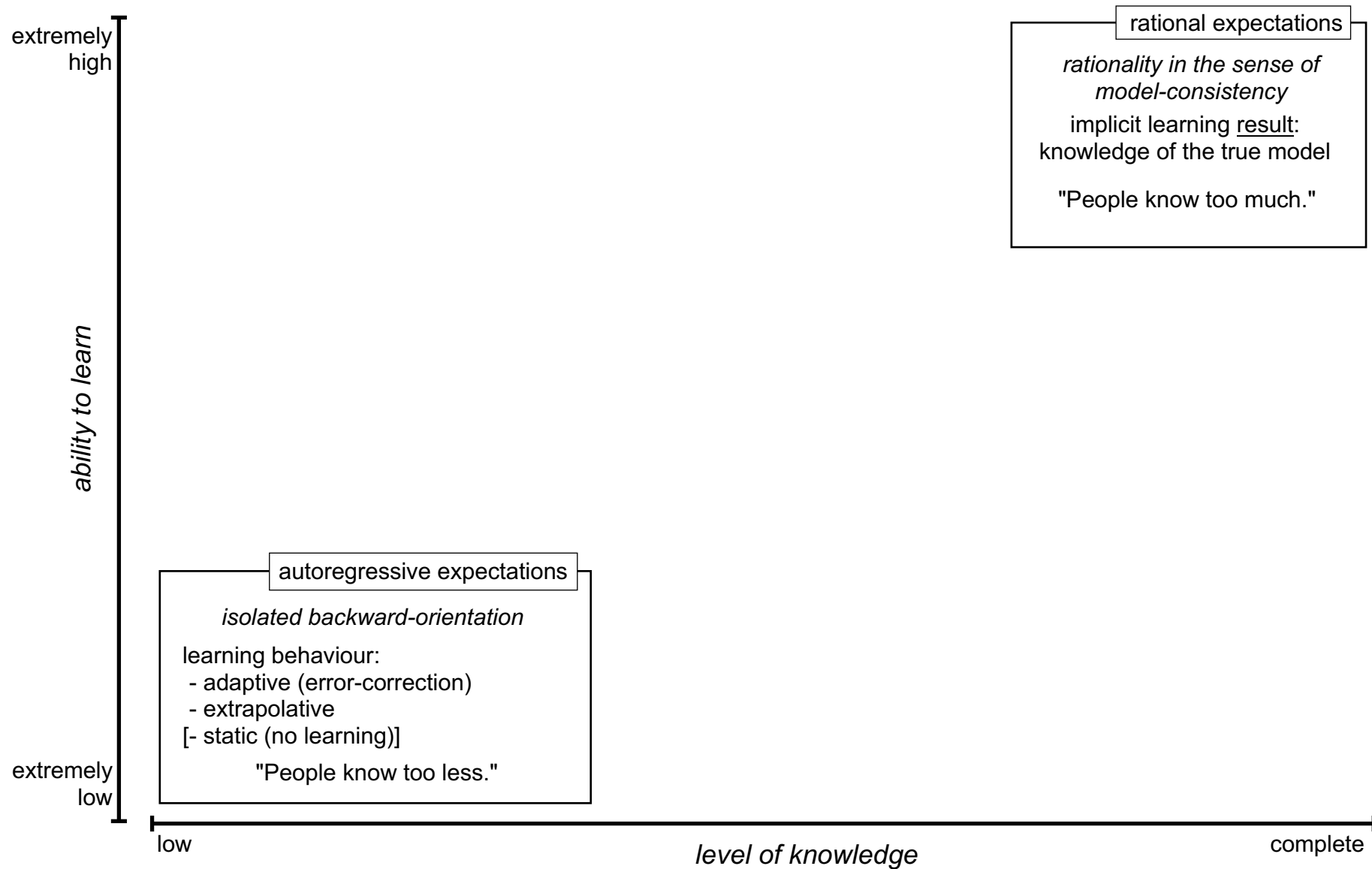
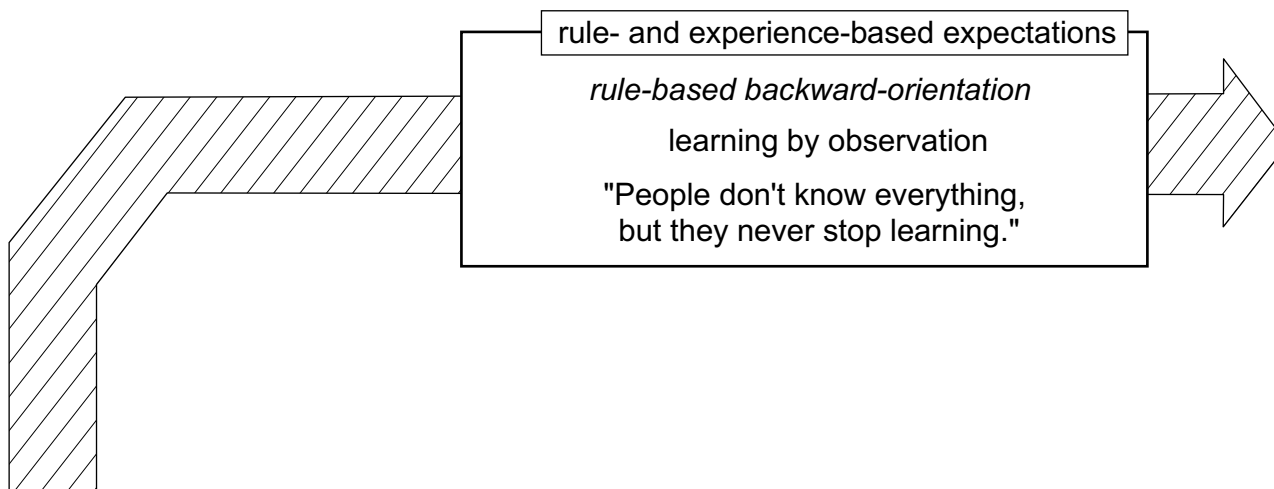


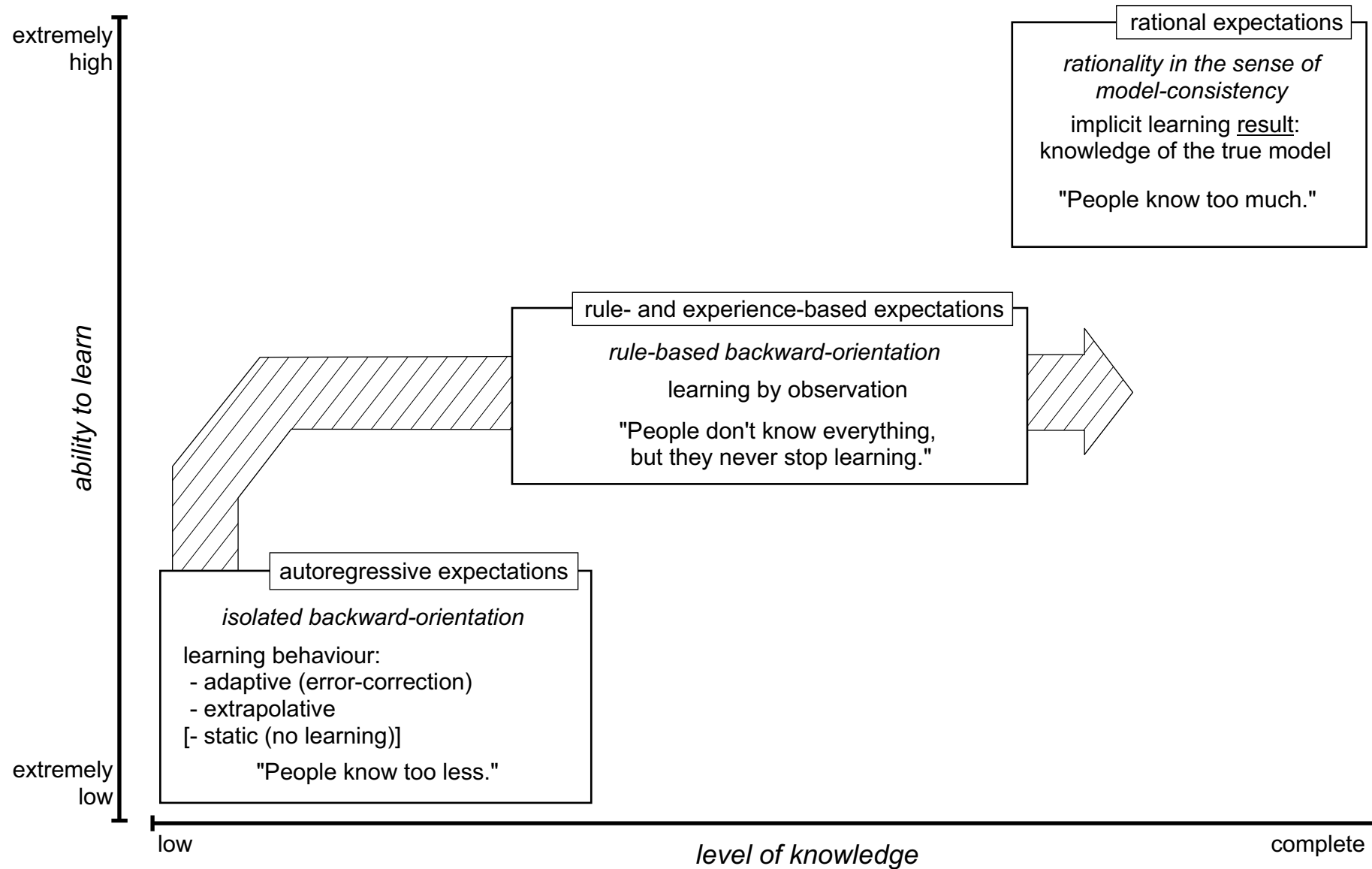
# **Modelling Rule- and Experience-based Expectations Using Neuro-Fuzzy Systems**

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**Institute for Industrial Economics**  
**University of Muenster/Germany**  
**kooths@uni-muenster.de**

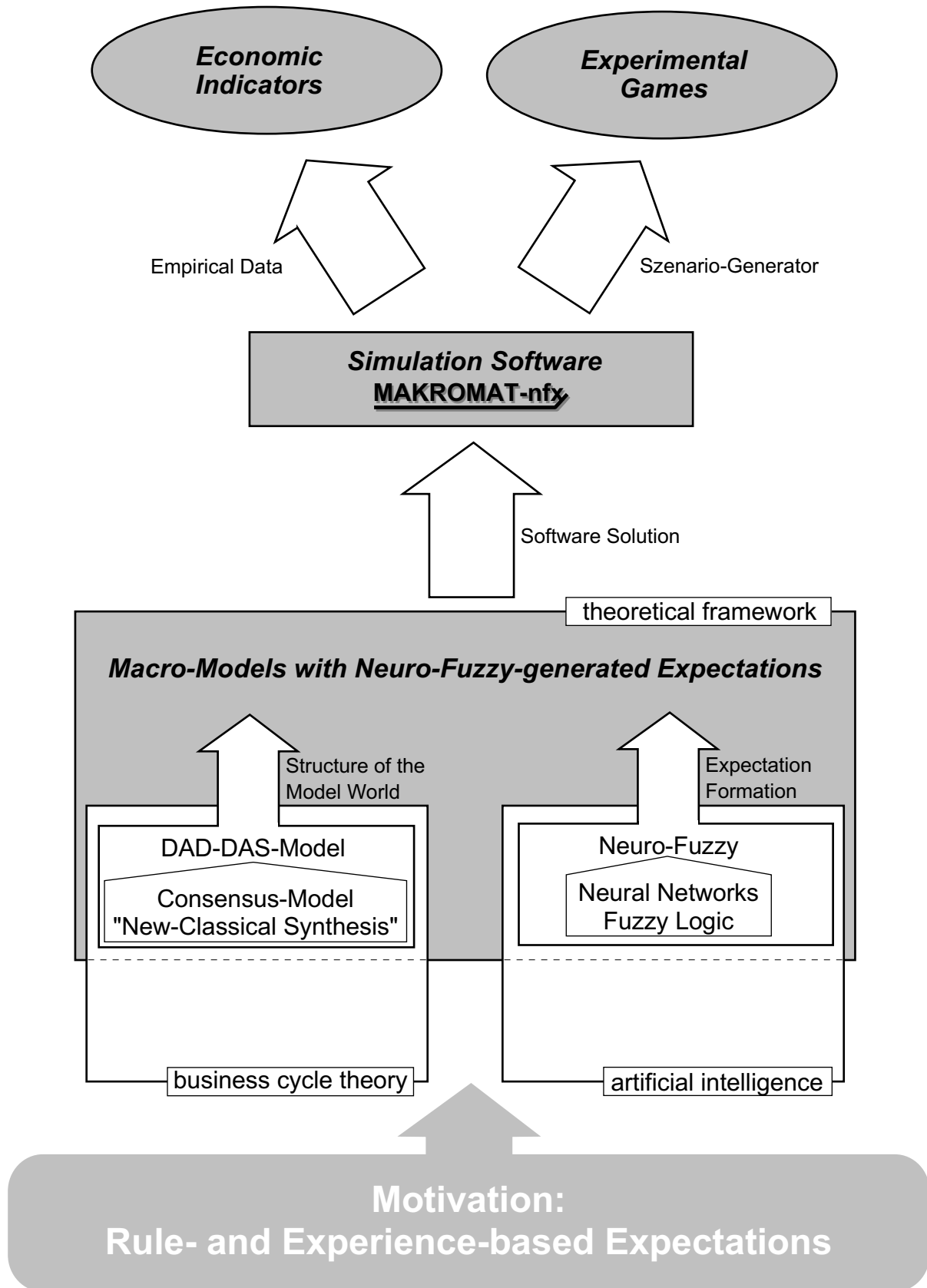
<http://www.makromat.de?cef99>

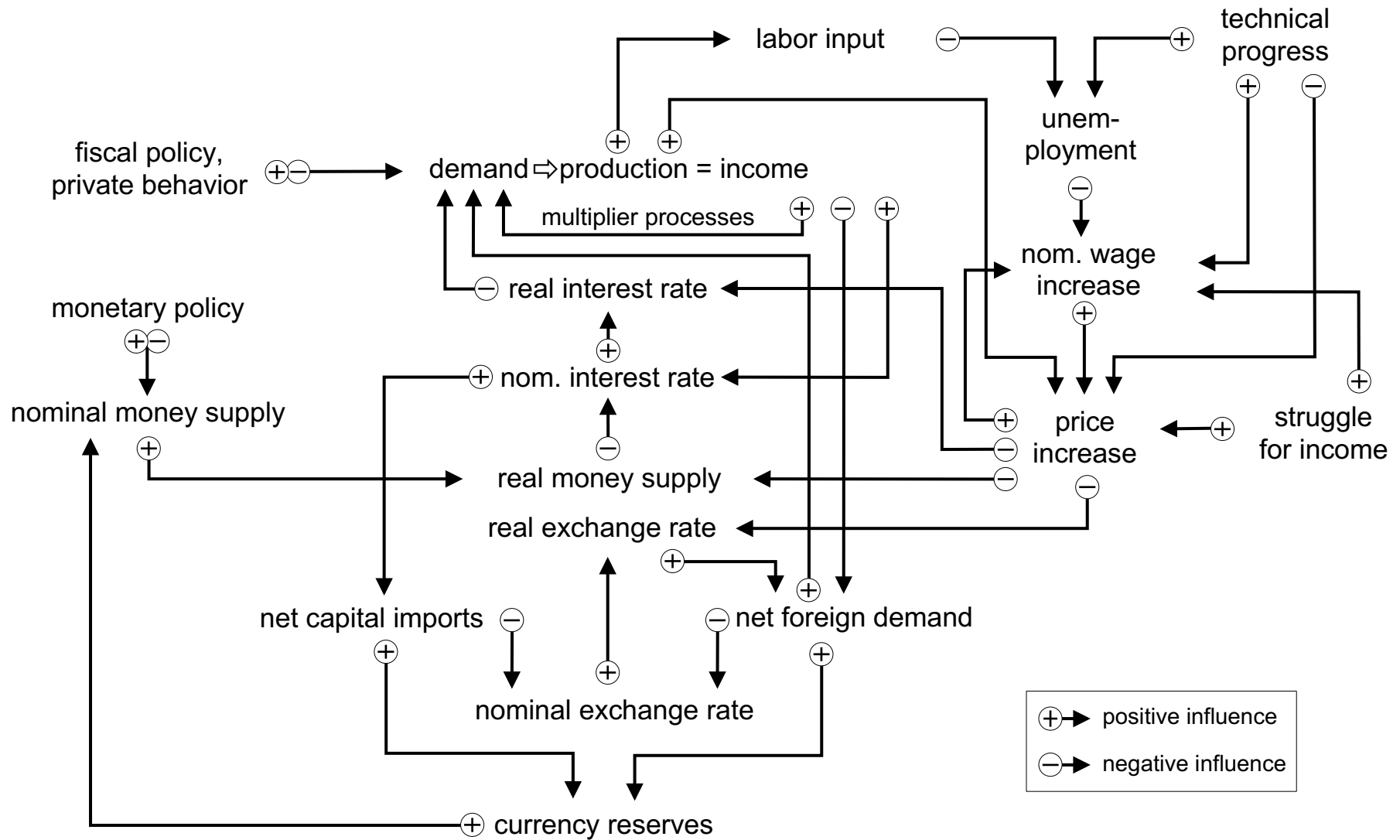












**MAKROMAT-nfx** File Edit Time Modelling Solve View Preferences Window Help

AF HHHH N X V W D E # 7 .# 2 BW1 = tL BW2 = tR

Fuzzifying Rule Base Defuzzifying Neuro Inference Learn. Proc.  Apply Rules  Learning

0 0 600

TZR: 1 (4) Tarifierverhandlung  
MZZR: 1 (4) aktive Geldpolitik

**G1 Equation System 1**

Model Structure for t=0

- Goods Market N = X (Equ.-Cond.)
  - Demand:  $N = C + I + G + Ex$ 
    - $C = 50 + 0,85 \cdot YLV^{exp} + 0,6 \cdot YUV^{exp} - 5 \cdot r^{exp}$
    - $I = 200 + 0,3 \cdot YUV^{exp} - 15 \cdot r^{exp}$
    - $G = 250 + 0,05 \cdot T^{exp}$
    - $Ex = 150 + 0,1 \cdot e^2$
    - $Y^{exp} = Y^{exp(-1)} + 0,5 \cdot [Y(-1) - Y^{exp(-1)}]$
    - $r^{exp} = i - gP^{exp}$ 
      - $gP^{exp} = gP(-1) + 0,5 \cdot [gP(-1) - gP^{exp(-1)}]$
  - Supply:  $X = Y + Im$ 
    - $Y = N^{exp} - Im^{exp}$

**G2 Equation System 2**

Model Structure for t=600

- Goods Market
  - Demand:  $N = C + I + G + Ex$ 
    - $C = 50 + 0,85 \cdot YLV^{exp} + 0,6 \cdot YUV^{exp} - 5 \cdot r^{exp}$
    - $I = 200 + 0,3 \cdot YUV^{exp} - 15 \cdot r^{exp}$
    - $G = 250 + 0,05 \cdot T^{exp}$
    - $Ex = 150 + 0,1 \cdot e^2$
    - $Y^{exp} = Y^{exp(-1)} + 0,5 \cdot [Y(-1) - Y^{exp(-1)}]$
    - $r^{exp} = i - gP^{exp}$ 
      - $gP^{exp} = gP(-1) + 0,5 \cdot [gP(-1) - gP^{exp(-1)}]$
  - Supply:  $X = Y + Im$ 
    - $Y = N^{exp} - Im^{exp}$

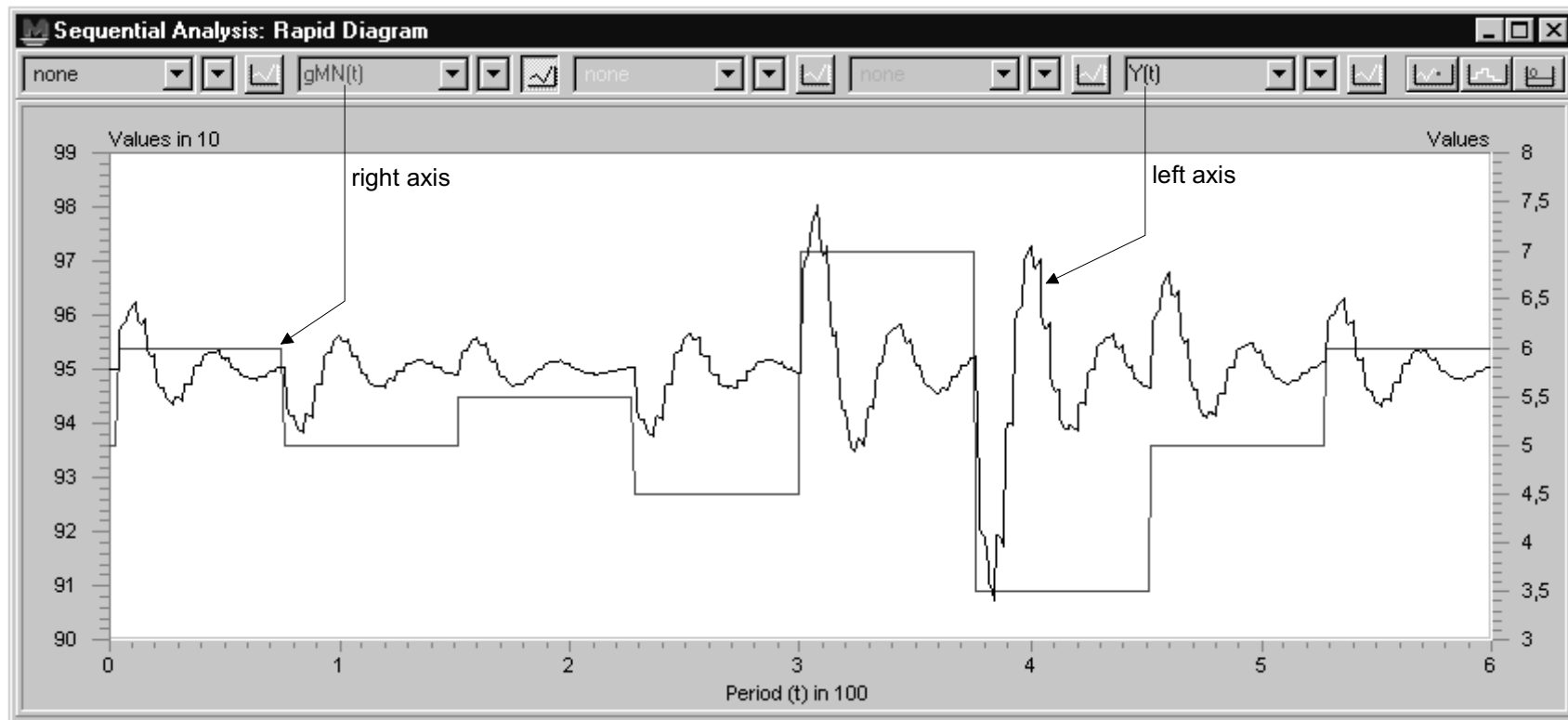
**E1 Model Results 1**

Variable	Value (t=0)	Diff. to t=0
Demand for Goods >>	1290,57	0,00
Supply of Goods >>	1290,57	0,00
Income >>	950,00	0,00
Disposable Income >>	729,19	0,00
Multiplier (simple) >>	1,27	0,00
Interest Rate, nom. (%)	12,43	0,00
Multiplier (interest-augmented)	0,30	0,00
Money Demand	725,27	0,00
Money Supply (real) >>	725,27	0,00
Private Saving	133,28	0,00
Public Budget Surplus	-54,73	0,00
Trade Surplus	-61,49	0,00

**E2 Model Results 2**

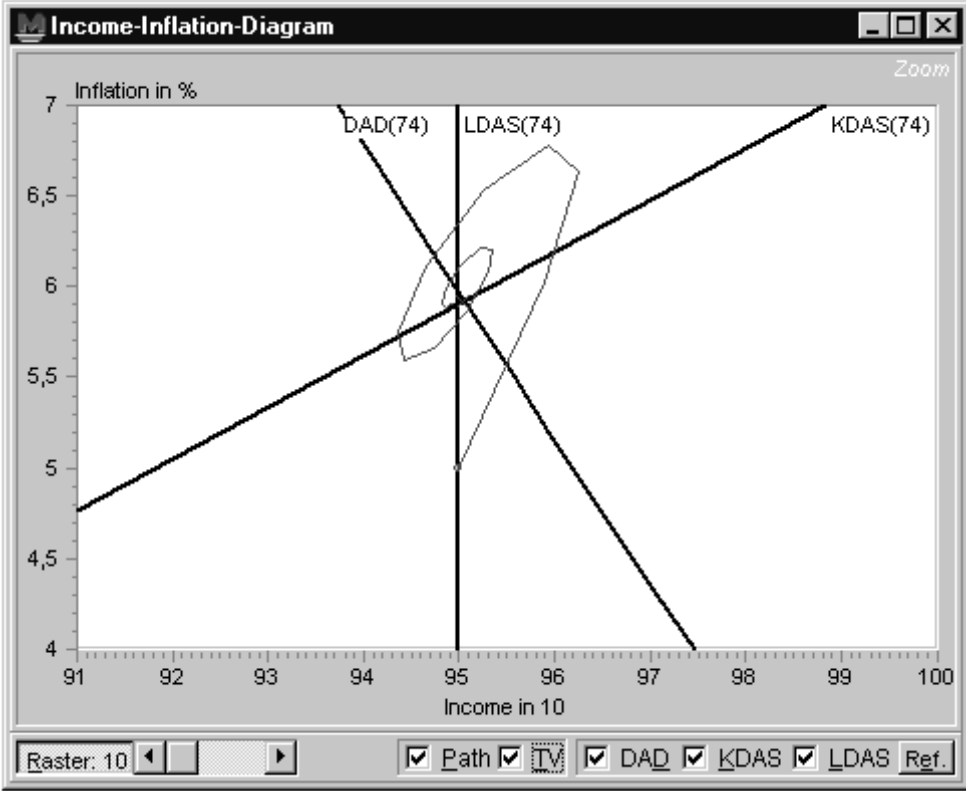
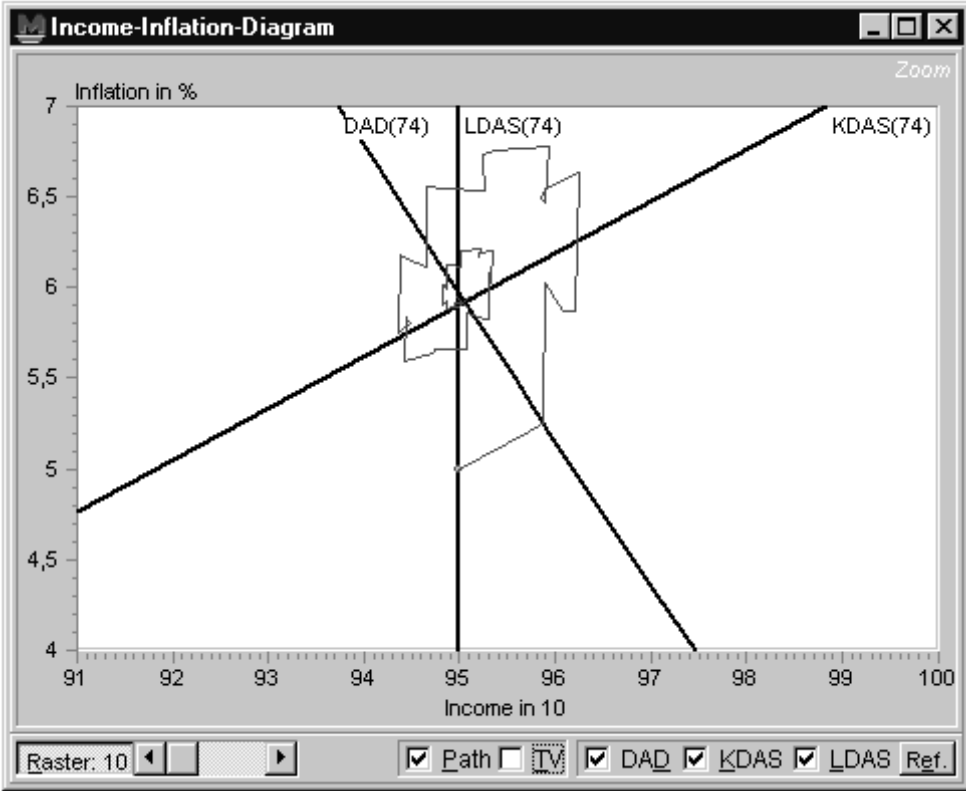
Variable	Value (t=600)	Diff. to t=0
Demand for Goods >>	1292,30	1,73
Supply of Goods >>	1291,52	0,95
Income >>	950,60	0,60
Disposable Income >>	729,52	0,33
Multiplier (simple) >>	1,27	0,00
Interest Rate, nom. (%)	12,94	0,51
Multiplier (interest-augmented)	0,30	0,00
Money Demand	723,48	-1,79
Money Supply (real) >>	723,72	-1,55
Private Saving	131,14	-2,15
Public Budget Surplus	-54,55	0,18
Trade Surplus	-69,16	-7,67

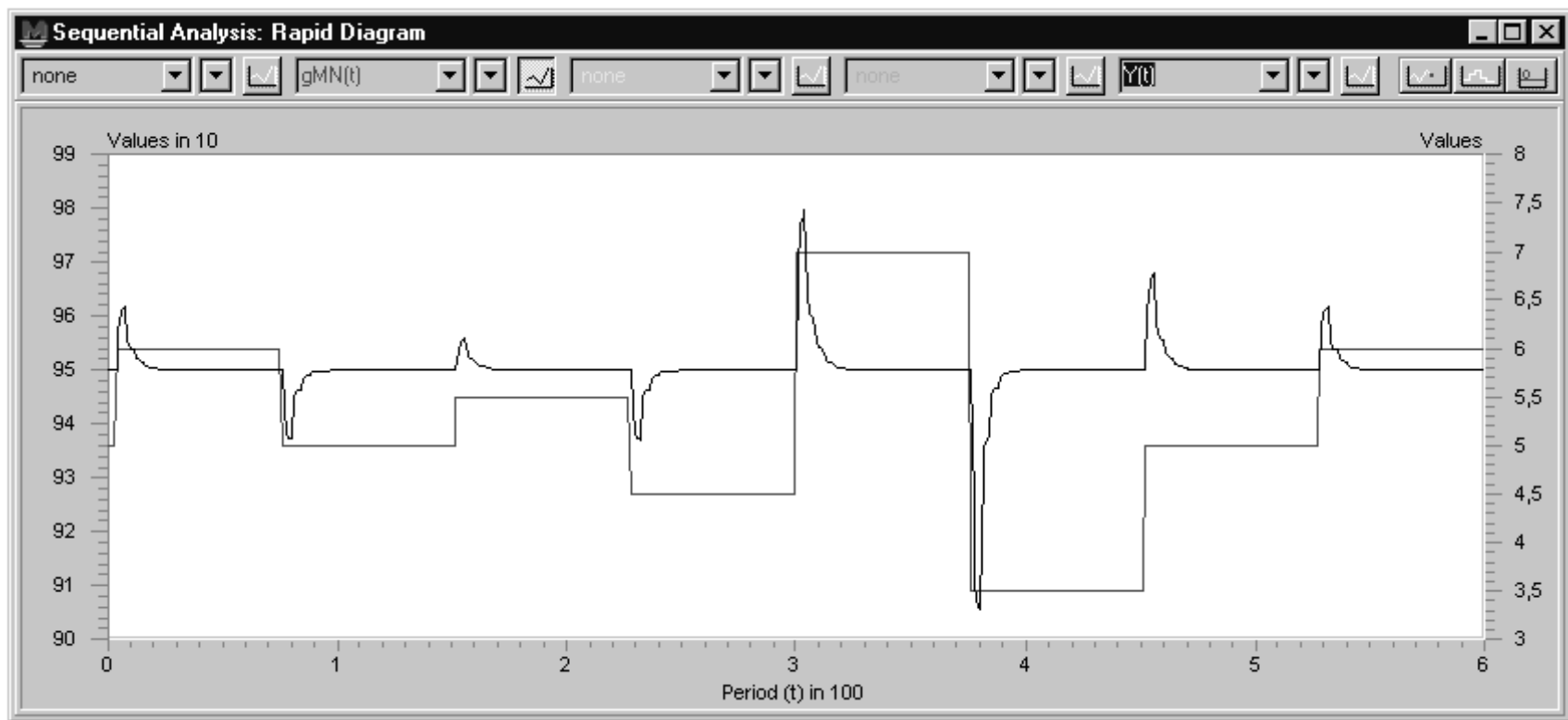
MAKROMAT-nfx +++ Macroeconomic Simulation System with Neuro-Fuzzy Generated Expectations +++ (c) KOOTHS 1998-1999 Ok demo-nfx1 (adaptive)

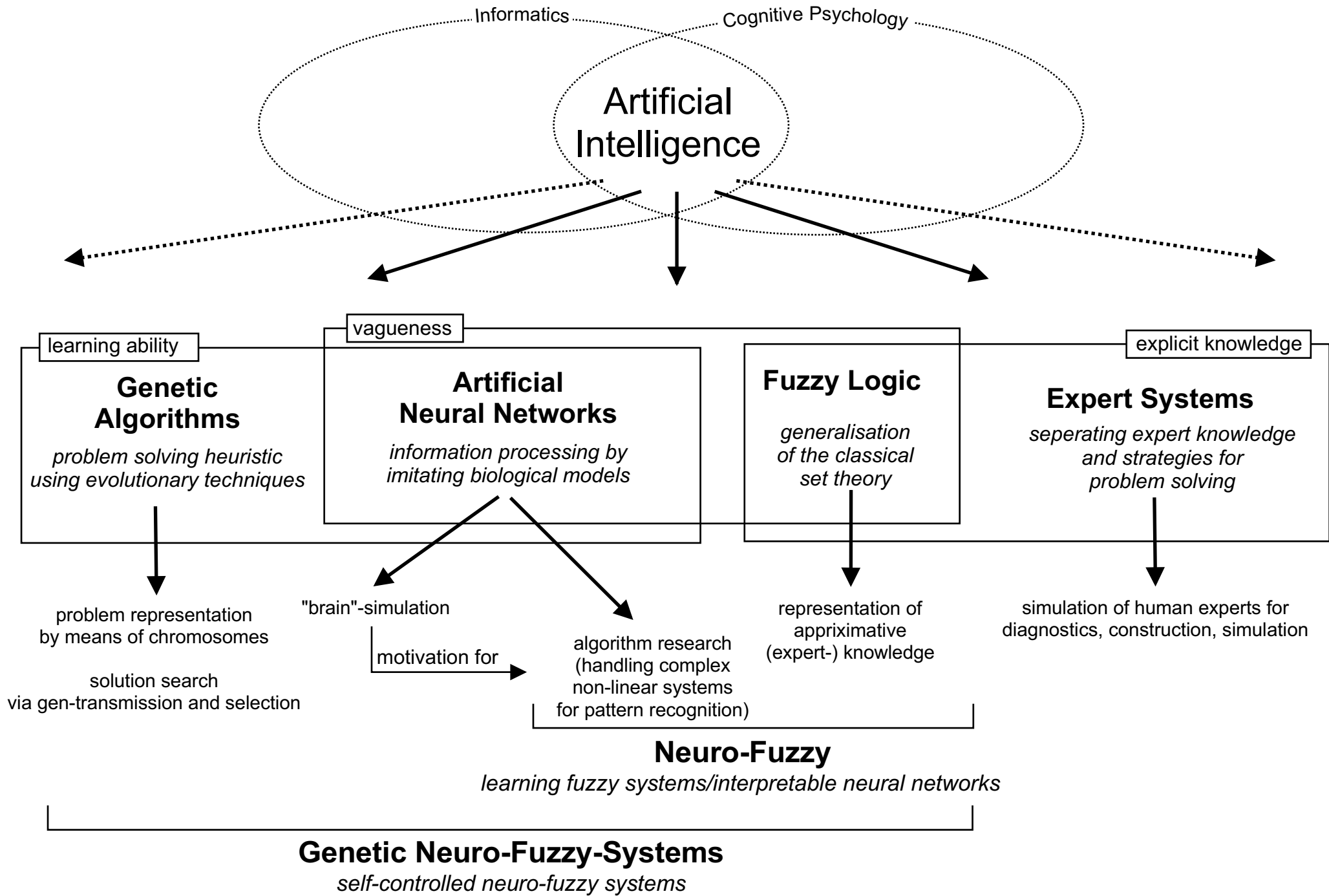


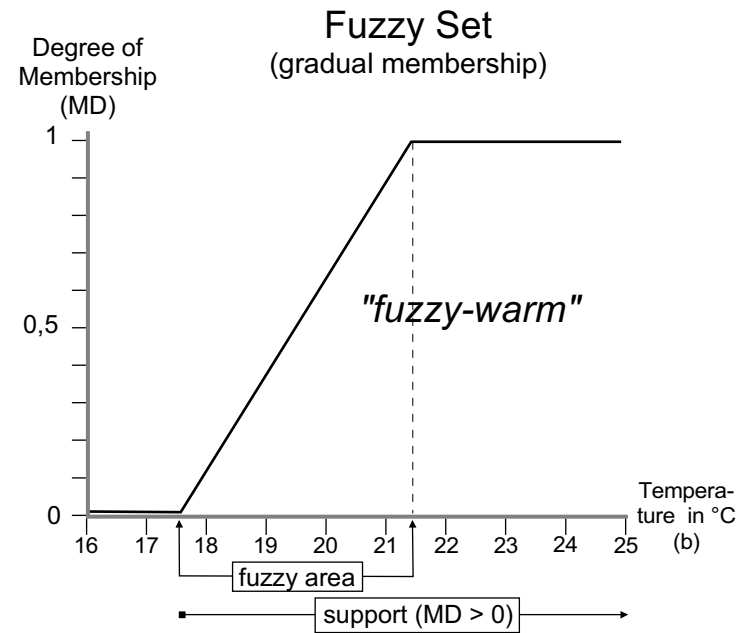
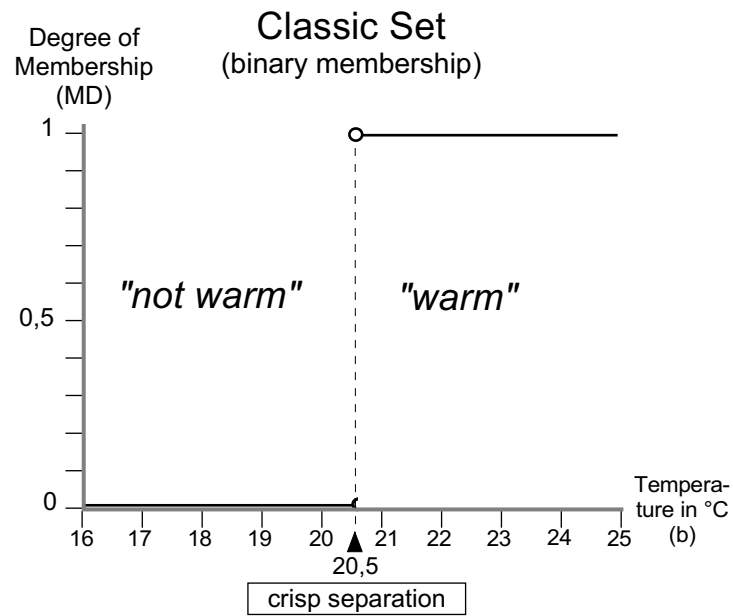
all periods

periods with wage bargaining

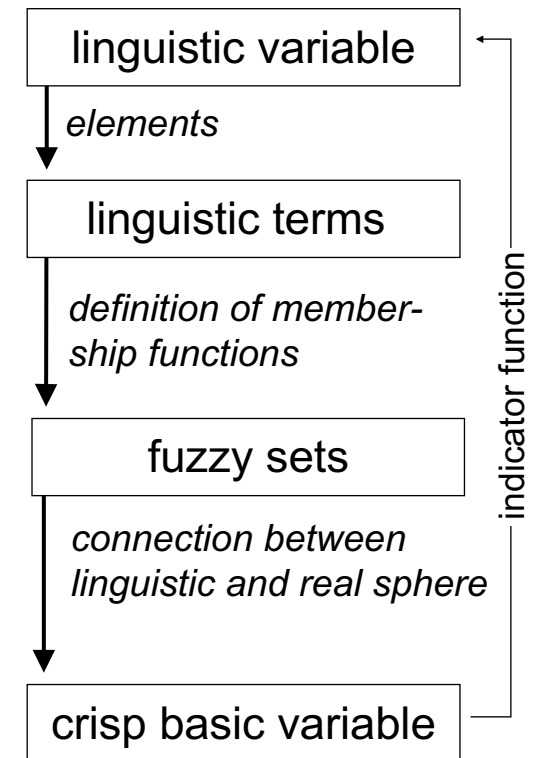
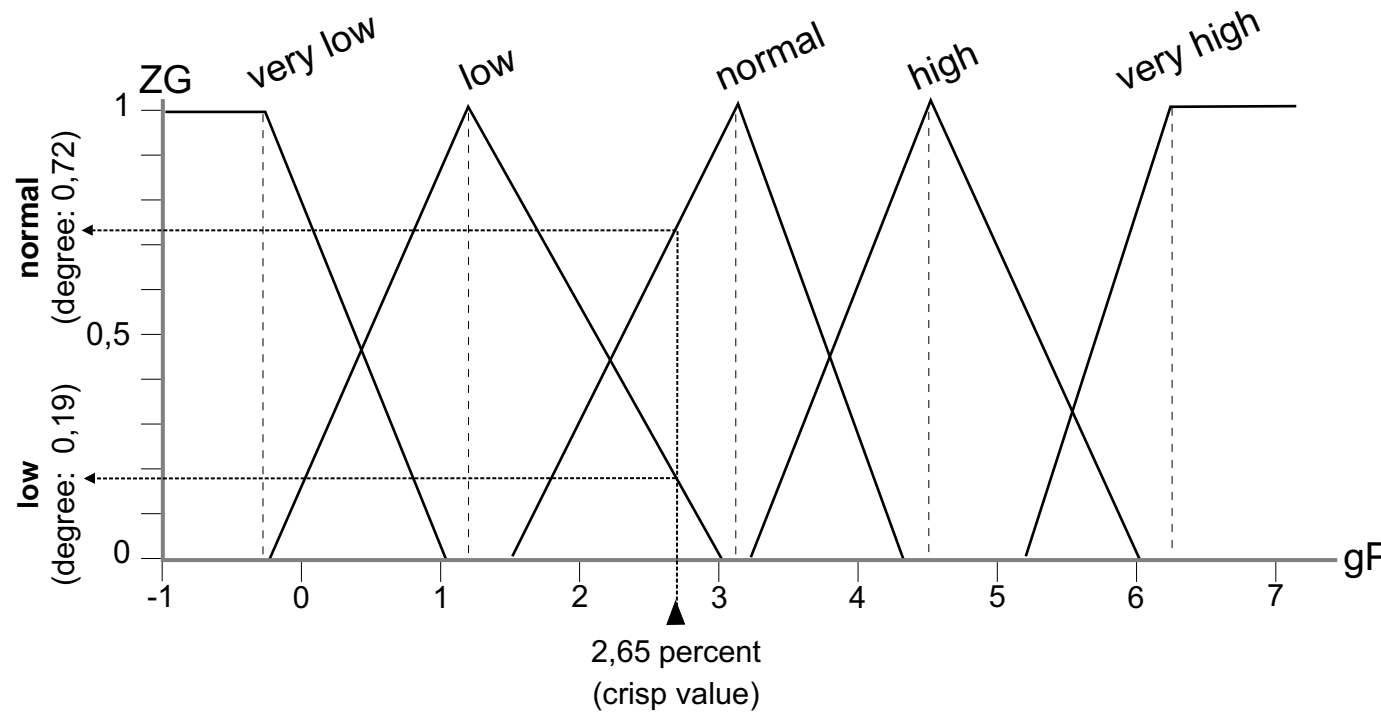








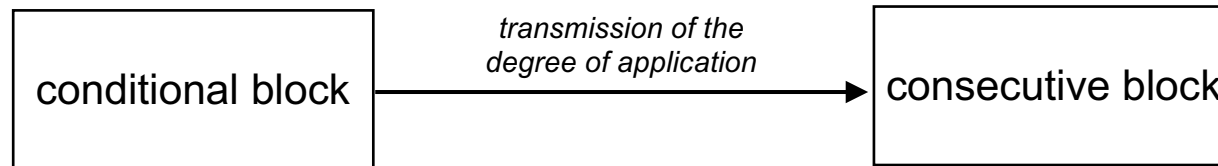
### fall in the value of money (inflation)



a) stylized form of a fuzzy rule

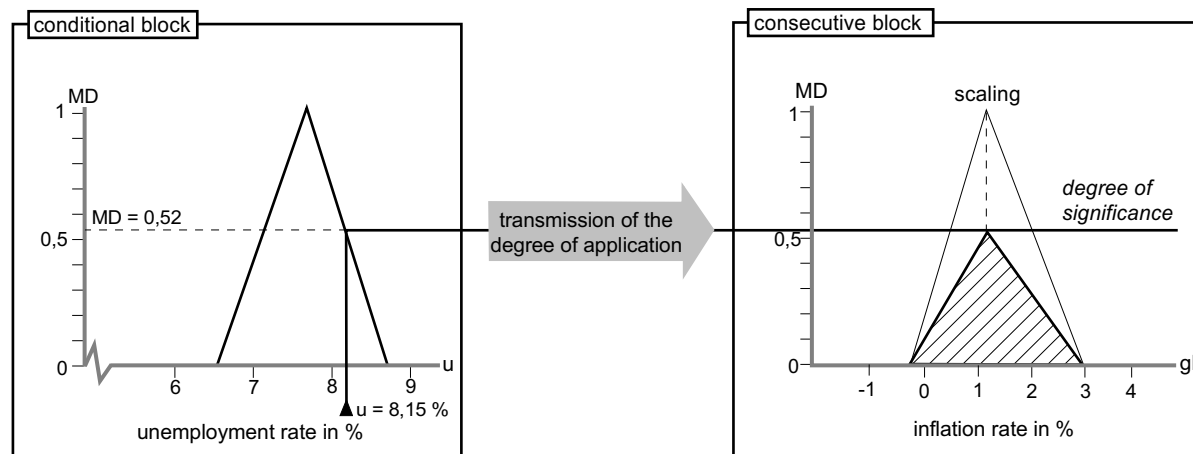


b) inference principle

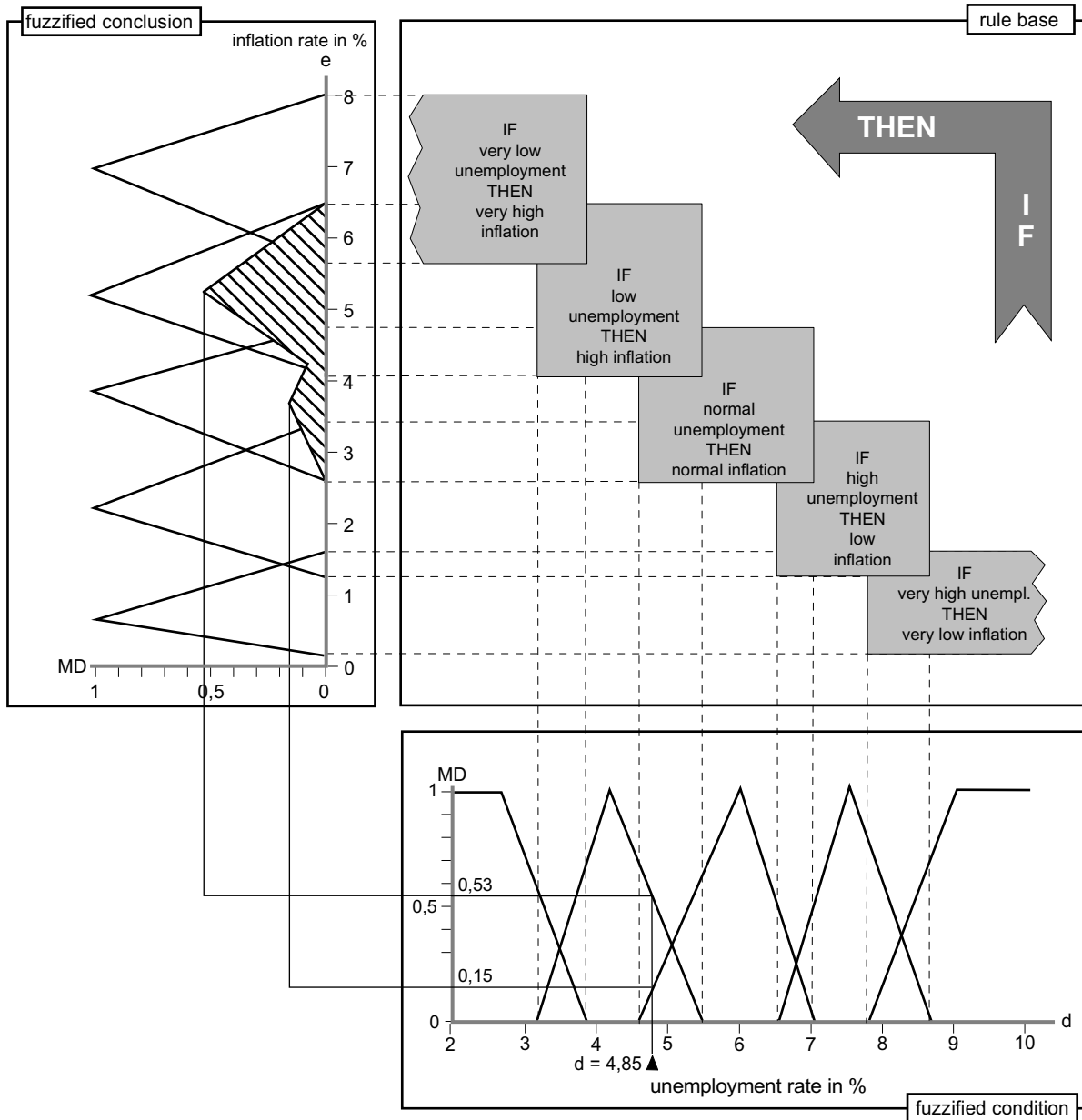


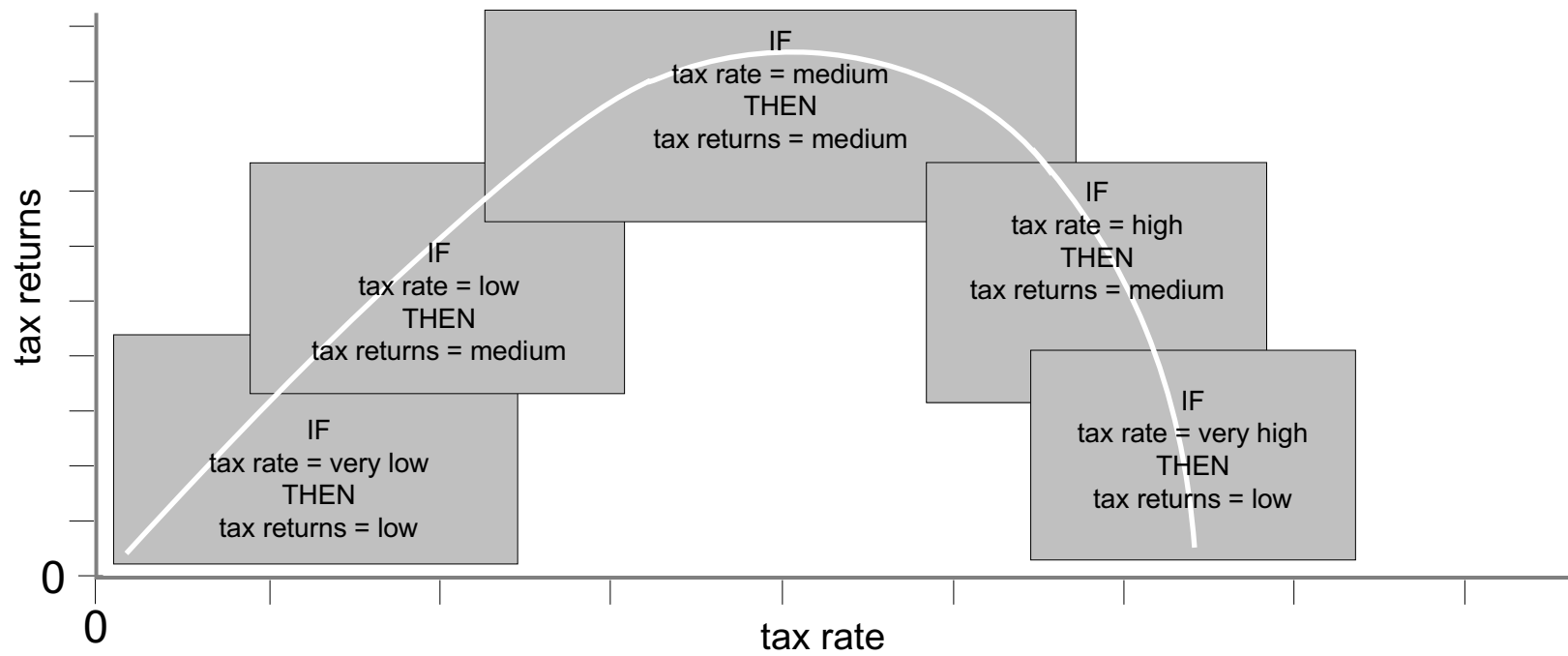
c) example (rule estimation by means of the scaling procedure)

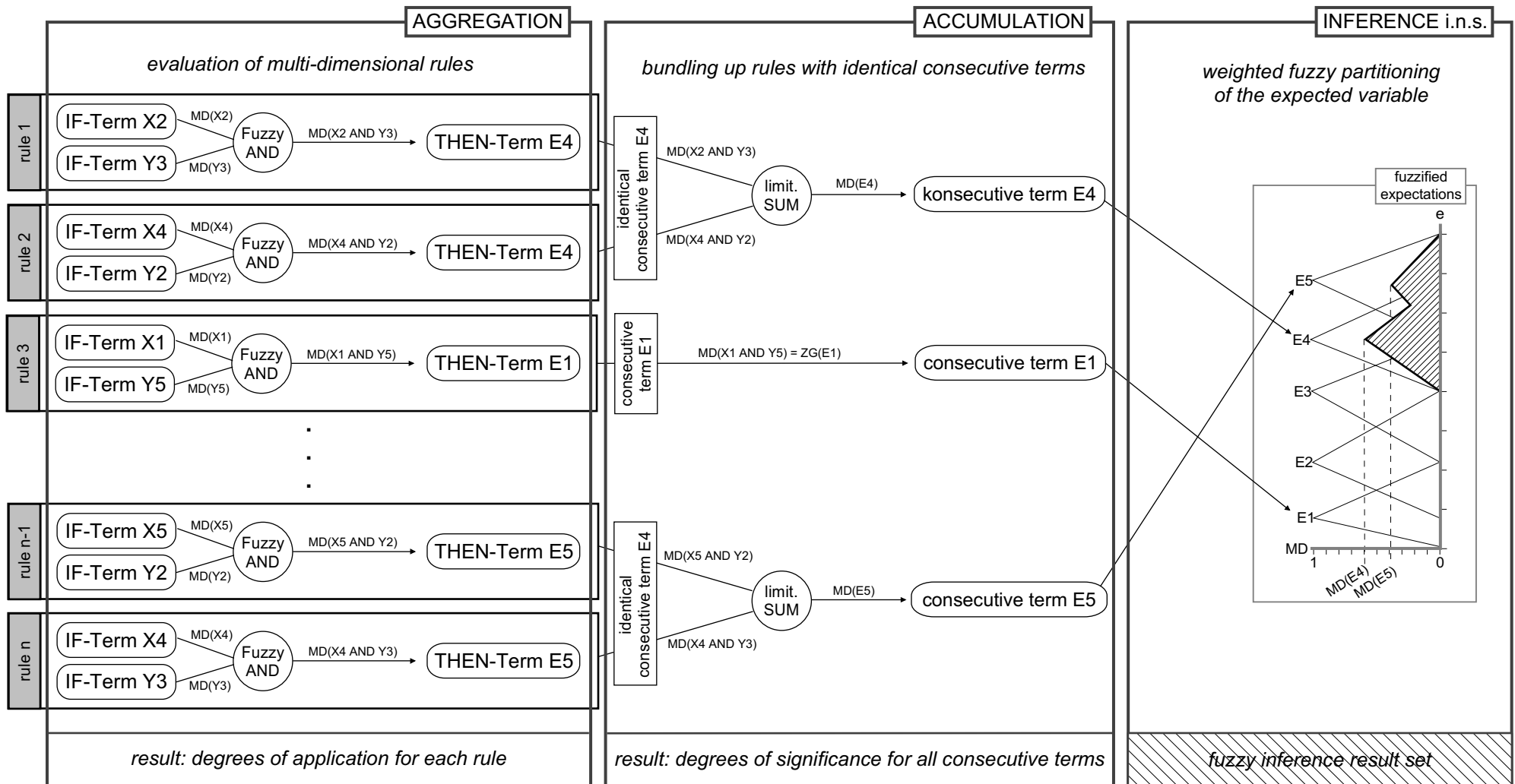
**IF** (unemployment = "high") **THEN** (inflation = "low")

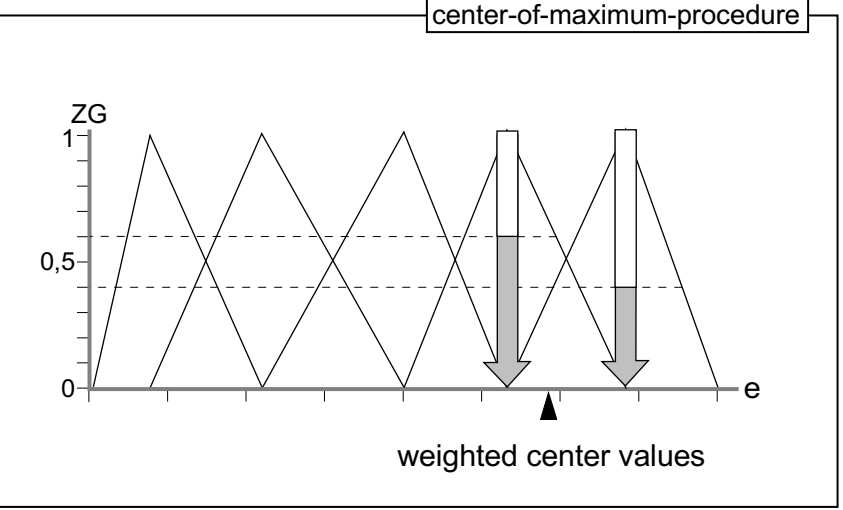
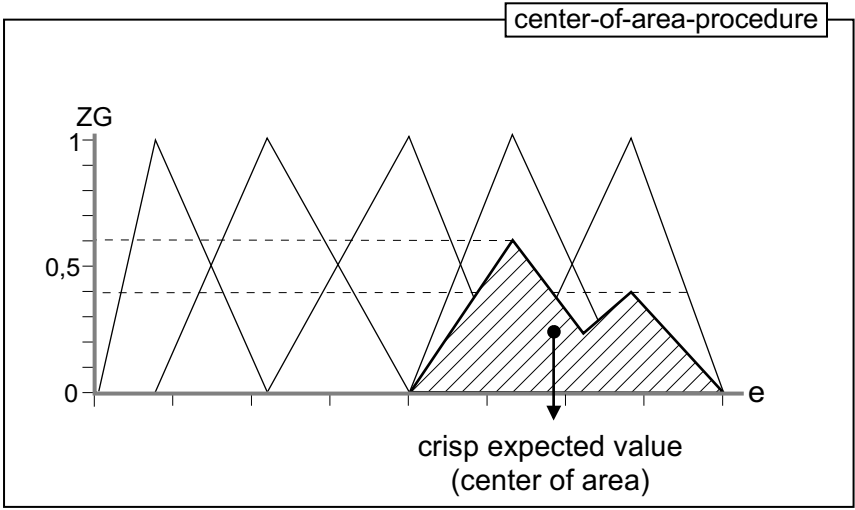


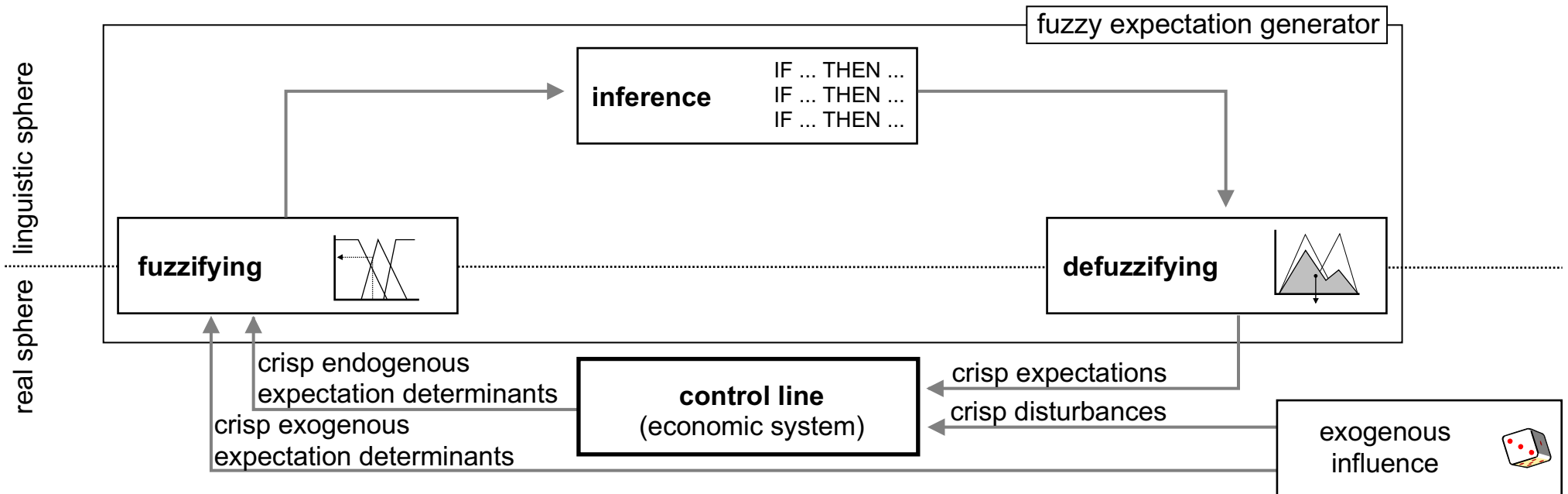
**Phillips-connection between unemployment and inflation**  
 ("the higher the unemployment rate, the lower the expected inflation rate")

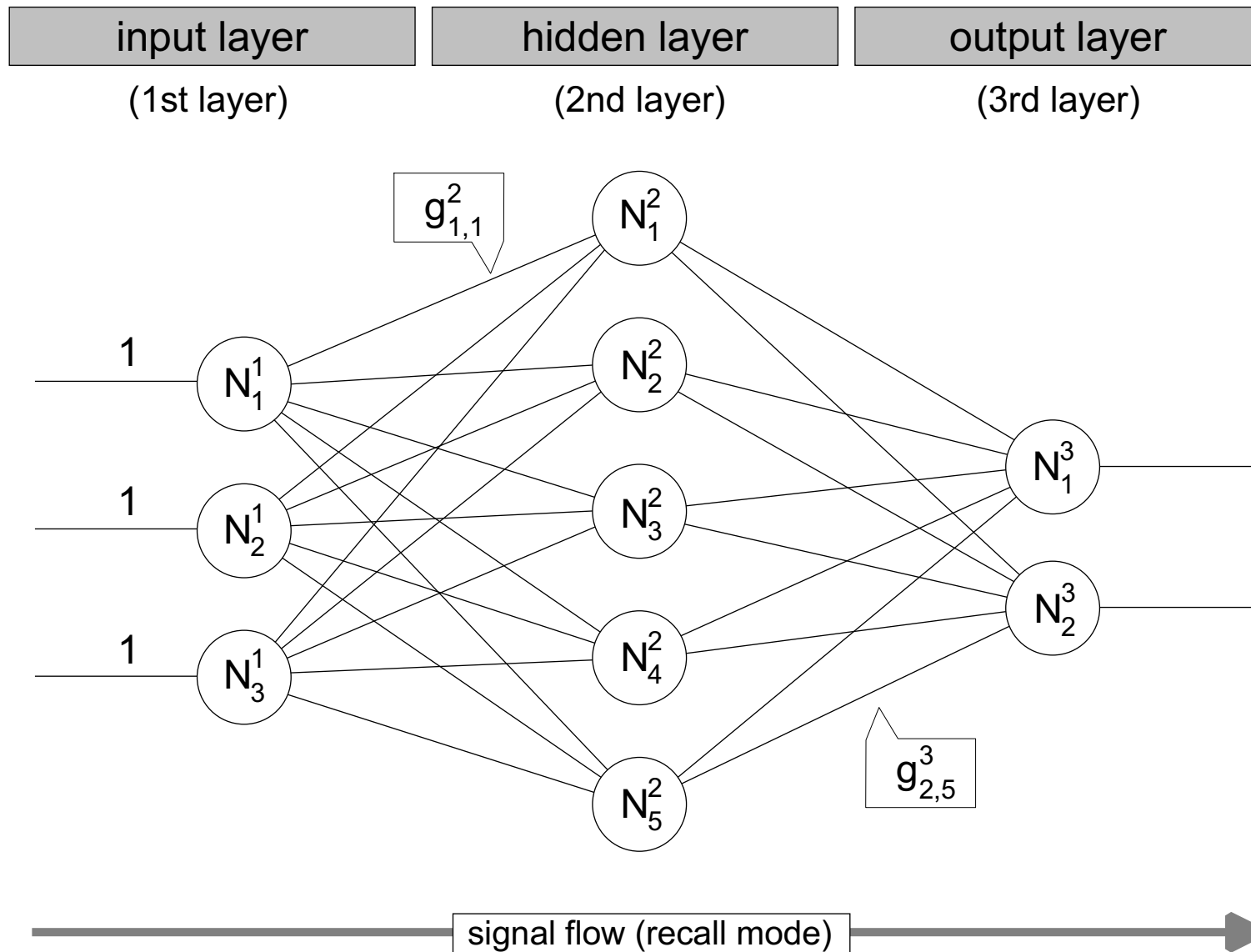


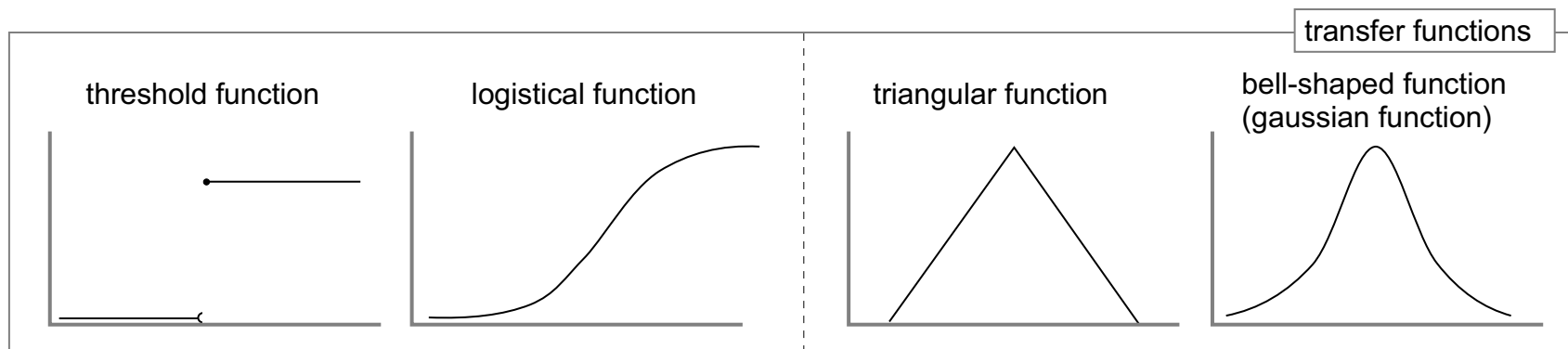
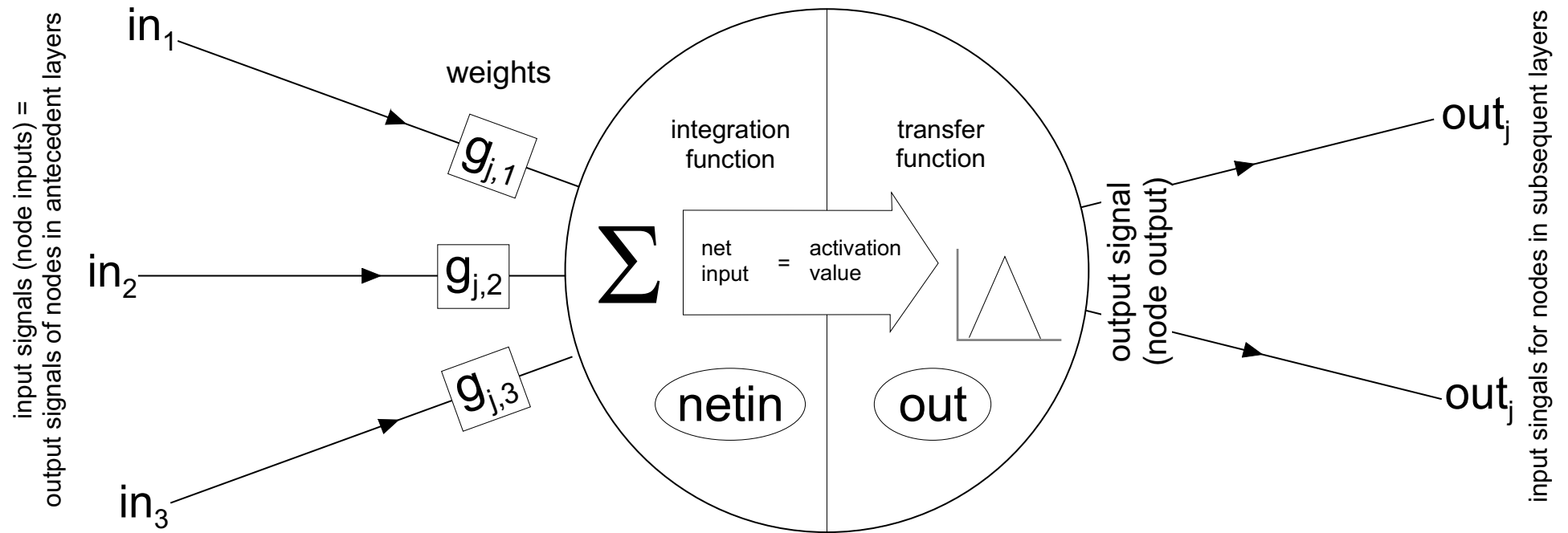


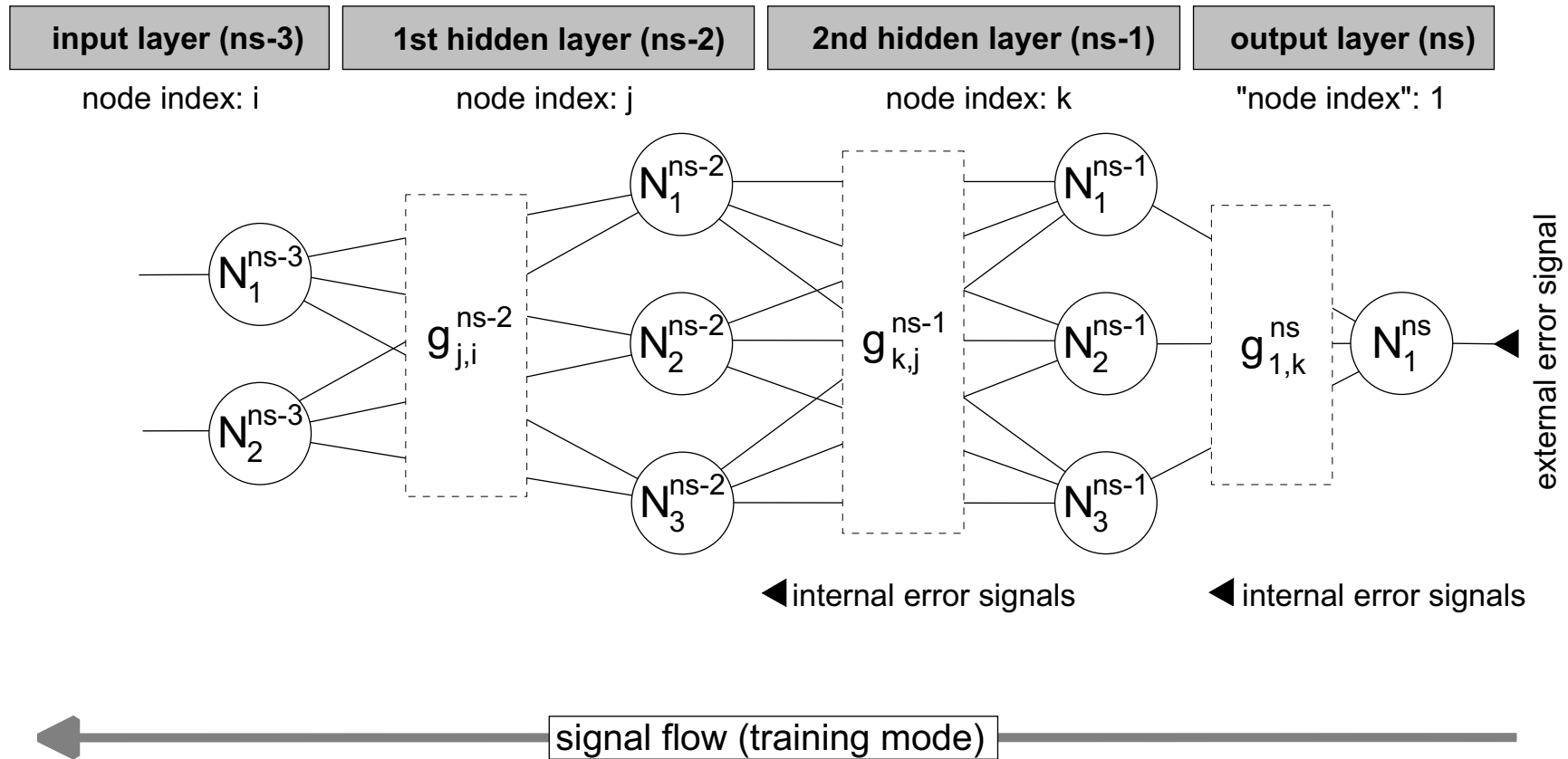


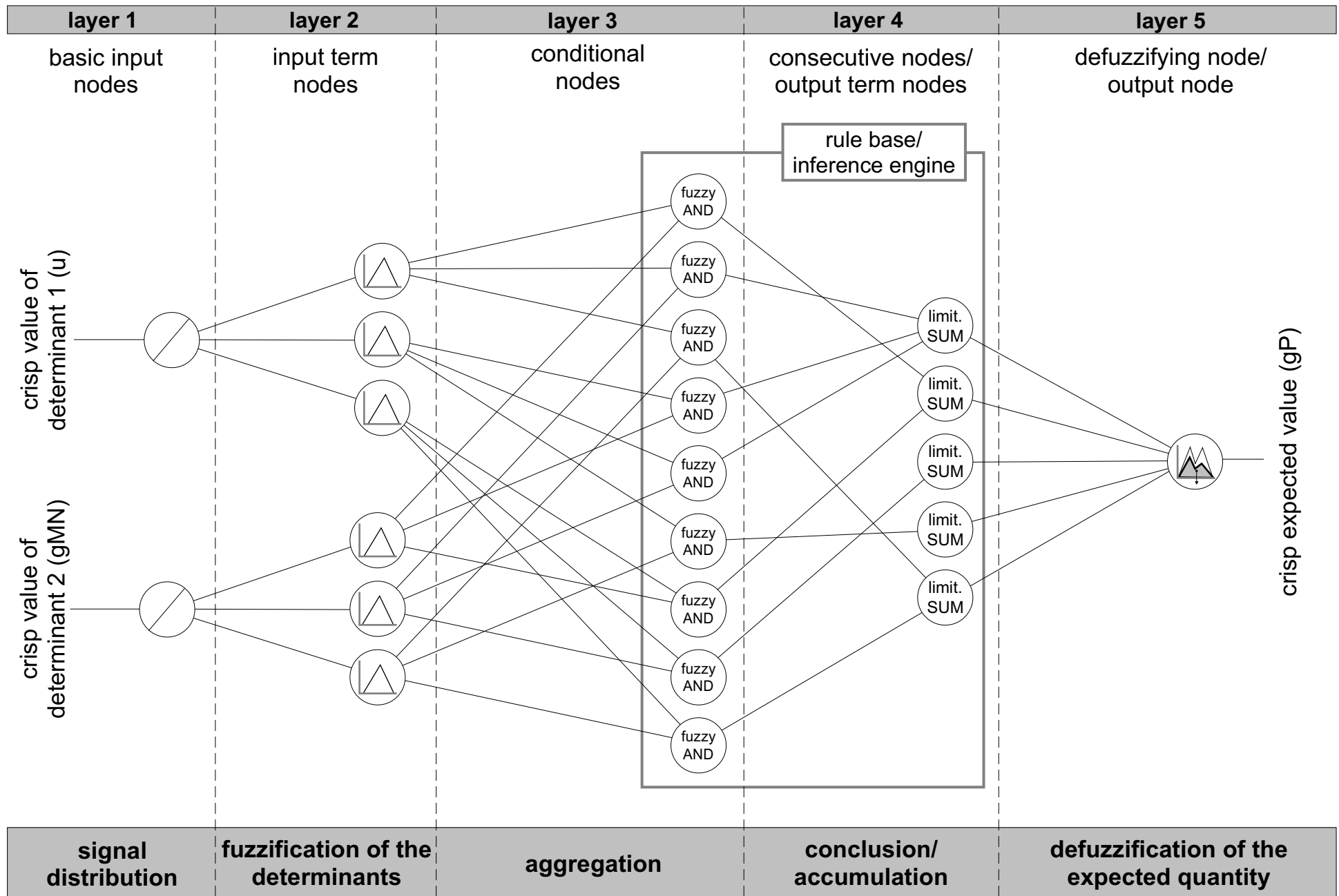


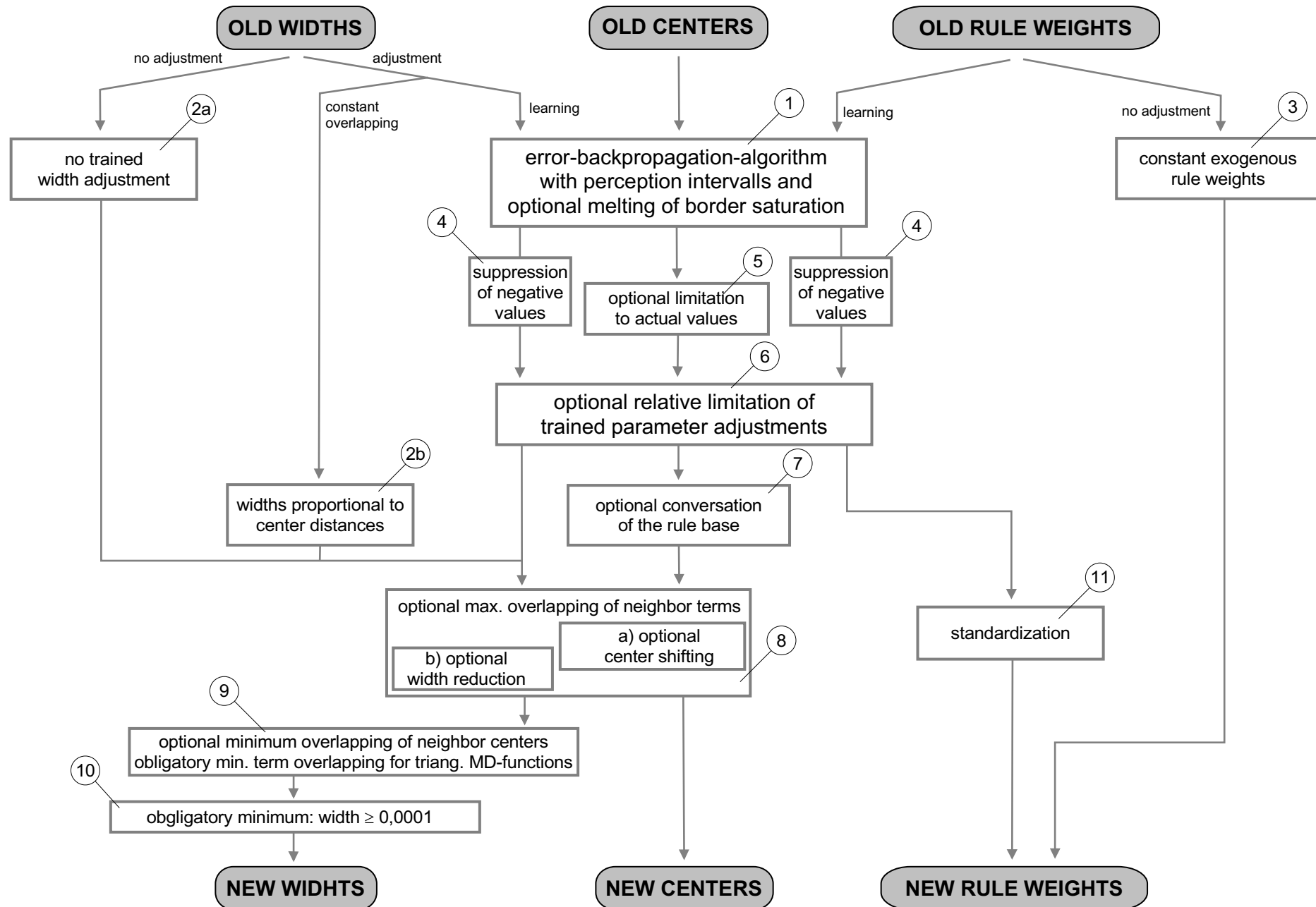


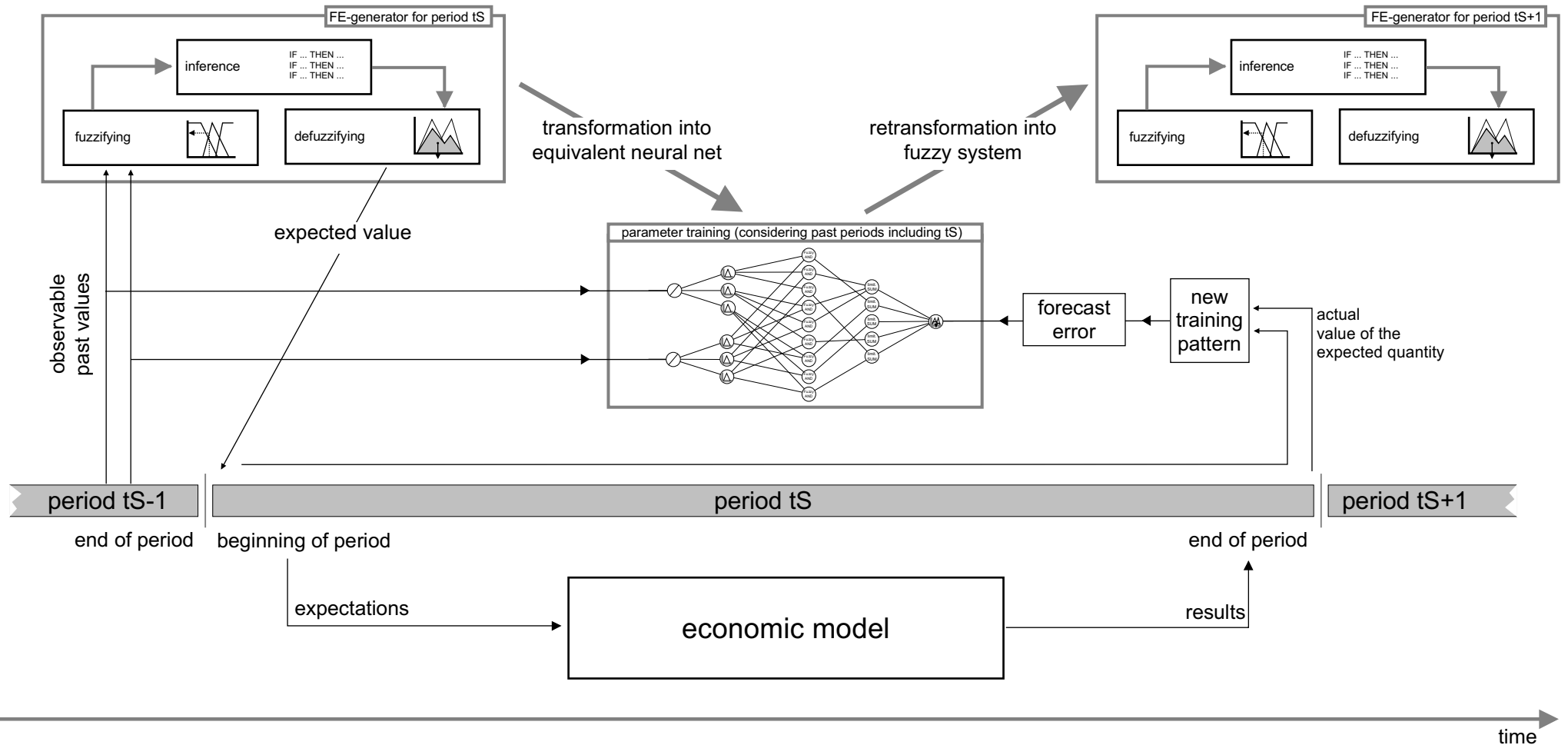


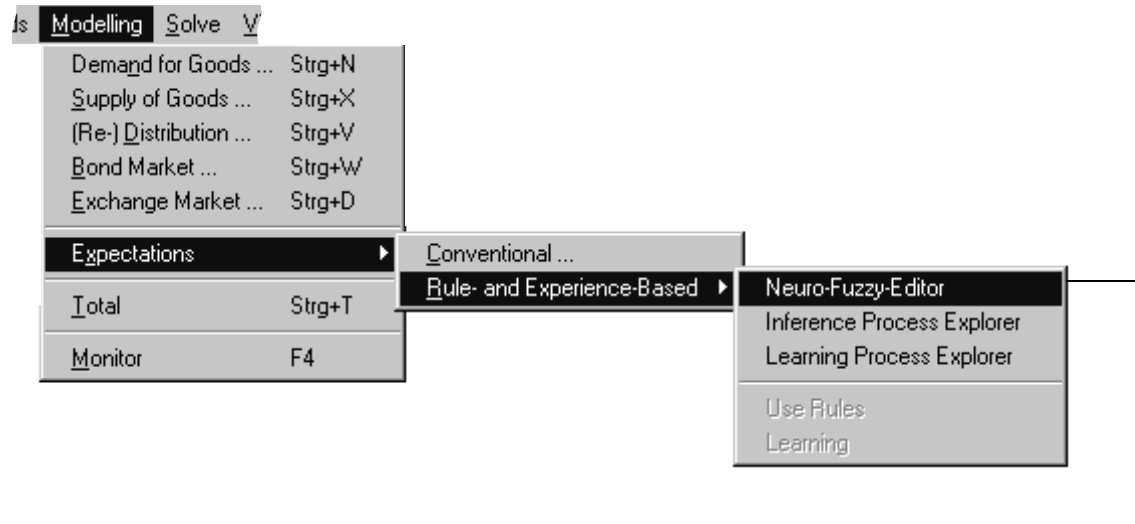












**Neuro-Fuzzy Editor for Rule- and Experience-based Expectations**

RT: Inflation Rate, exp. (gP.exp)

Determinant 1: Unemployment Rate (u) Lag: 1 Diff.: 0

Determinant 2: Monetary Growth Rate, nom. (gMN) Lag: 1 Diff.: 0

Determinant 3: no entry Lag: 1 Diff.: 0

Degree of Membership

Term Shape (for all rules):  Gauss (bell-shaped)  triangular

Border Saturation  Center-Symmetry

Term Count (for all rules): Expected Quantity 5 7

Determinants 3 5

Terms / Clust. / C-Opt. / Scale

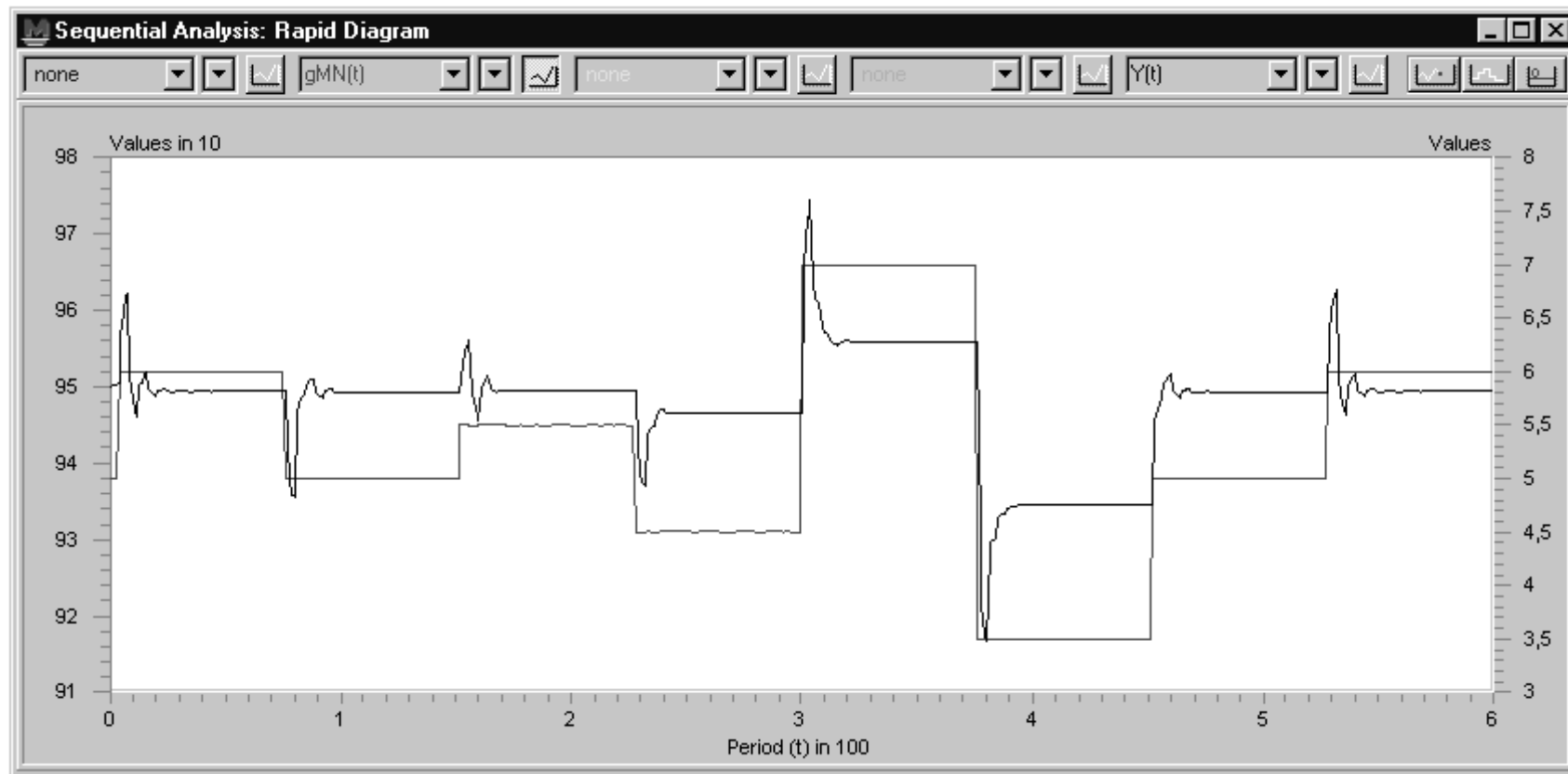
Term:	very low	low	normal	high	very high
Center:	4,66	5,14	5,63	6,23	6,69
Weite:	0,29	0,29	0,36	0,36	0,28

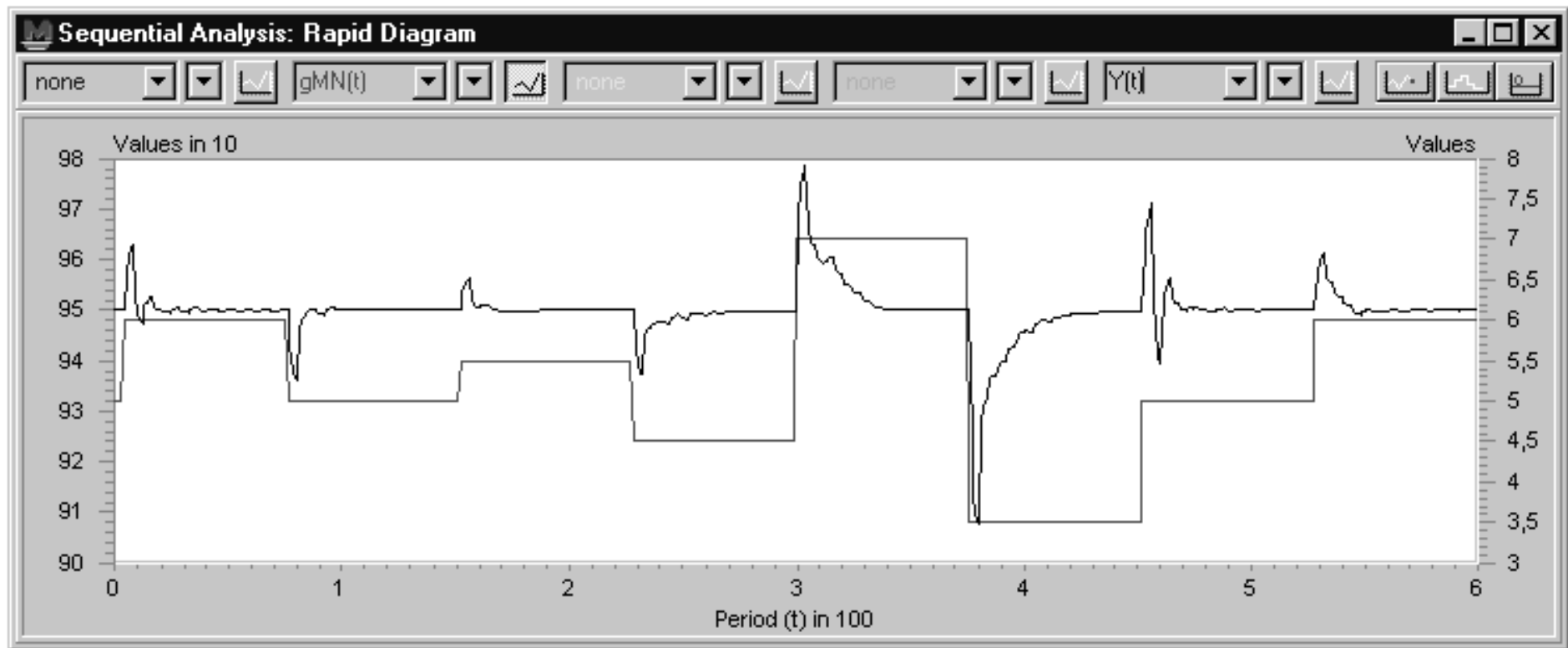
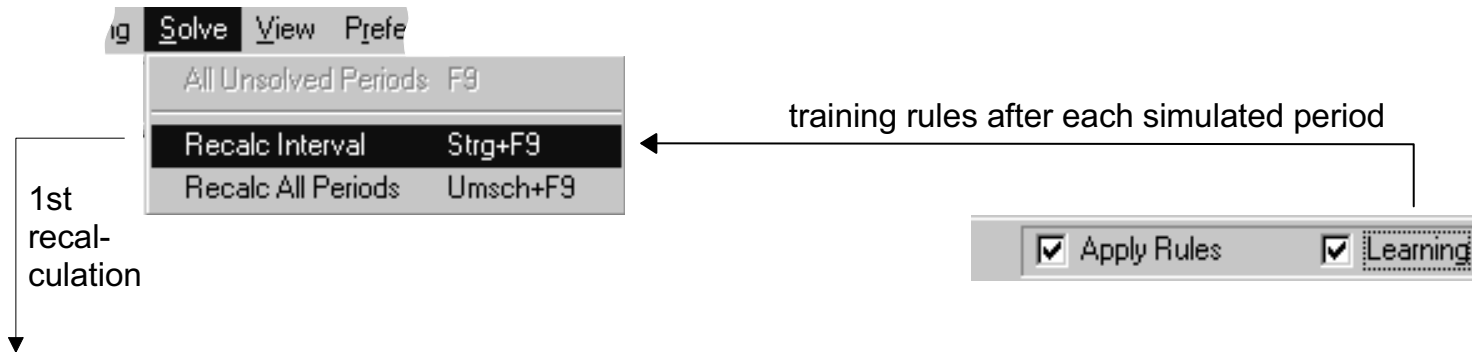
Fuzzifying / Rule Base / Defuzzifying / Neuro

NEW MOD. DEL. Ok Can. ?

replaces conventional expectations by rule-based expectations

Apply Rules     Learning





g **Solve** View Prefe

All Unsolved Periods F9

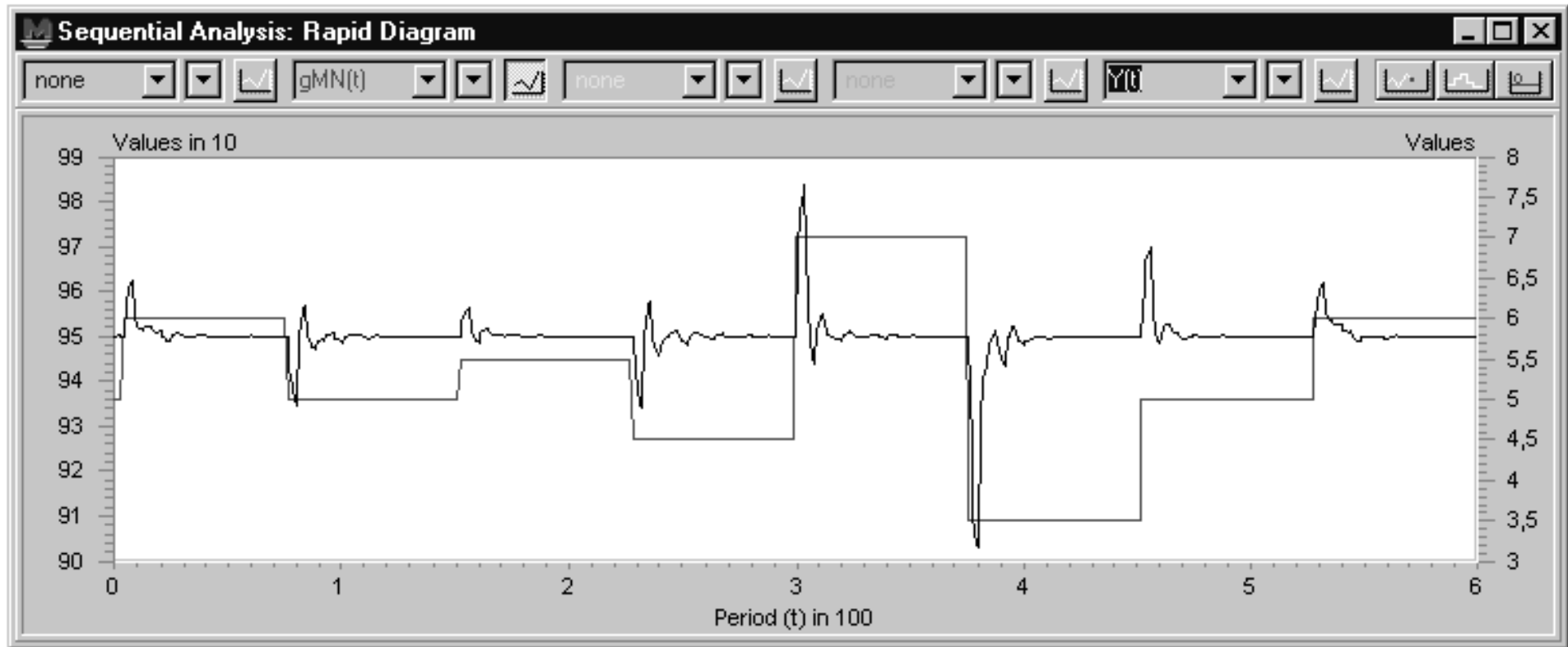
Recalc Interval Strg+F9

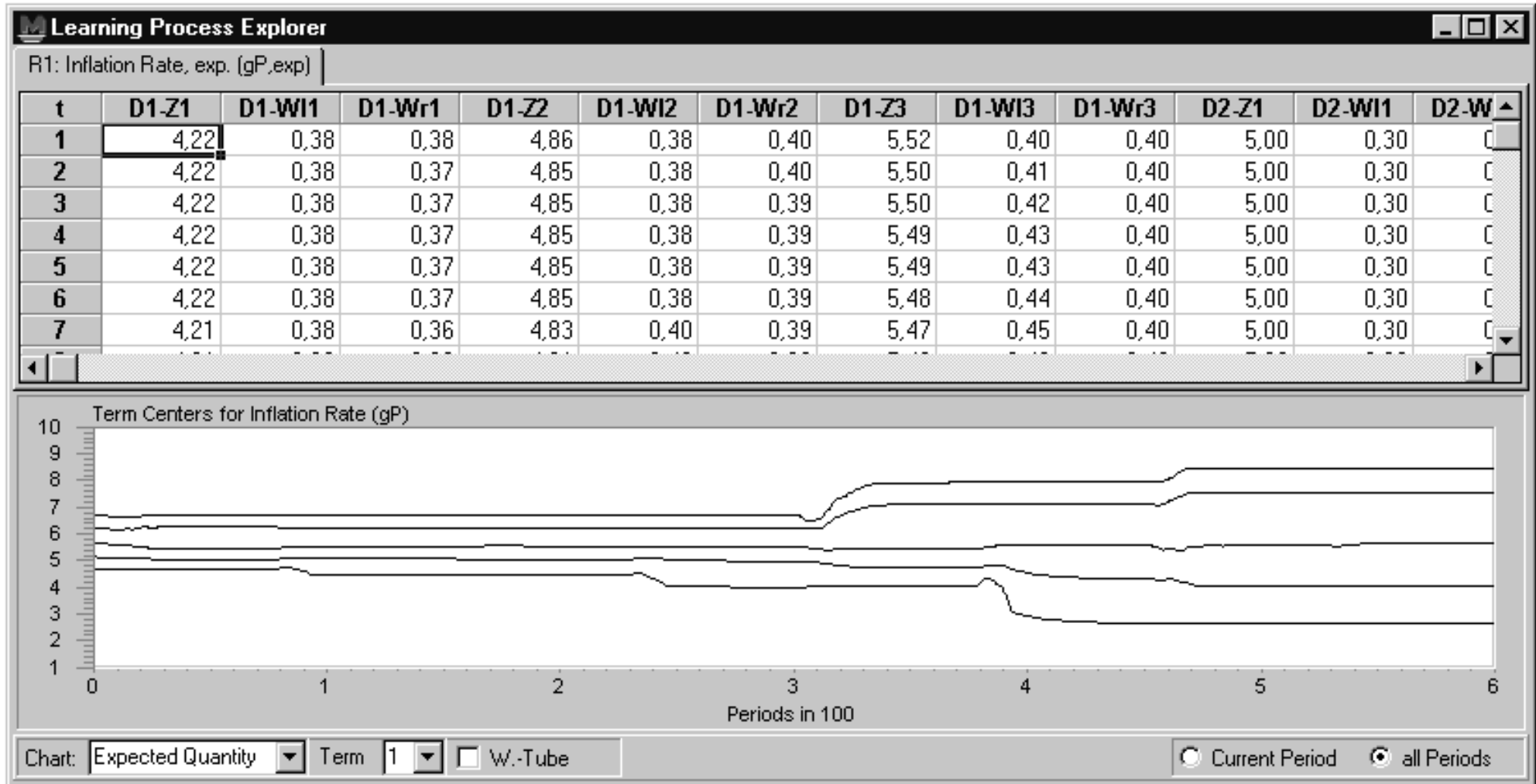
Recalc All Periods Umsch+F9

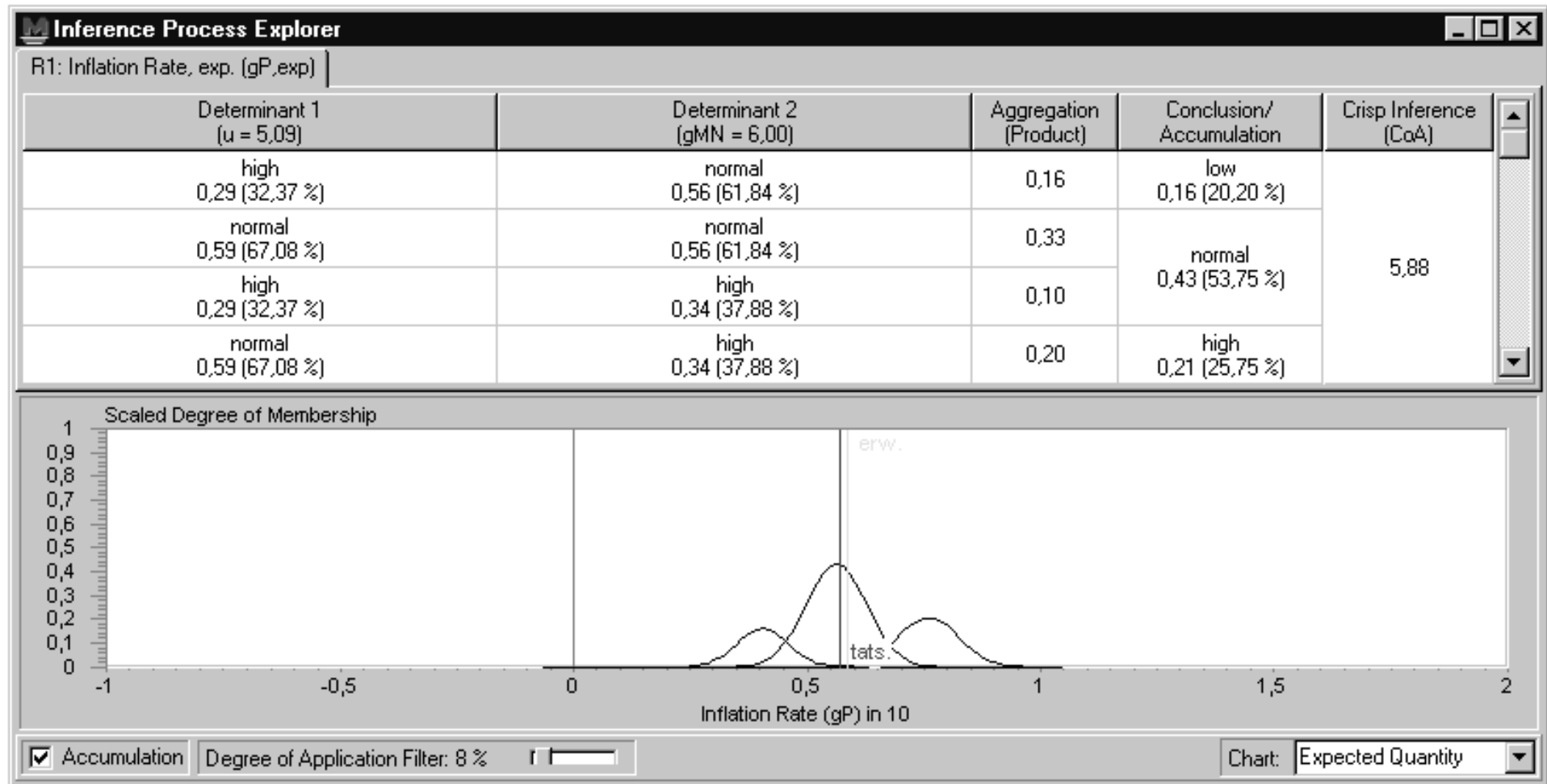
training rules after each simulated period

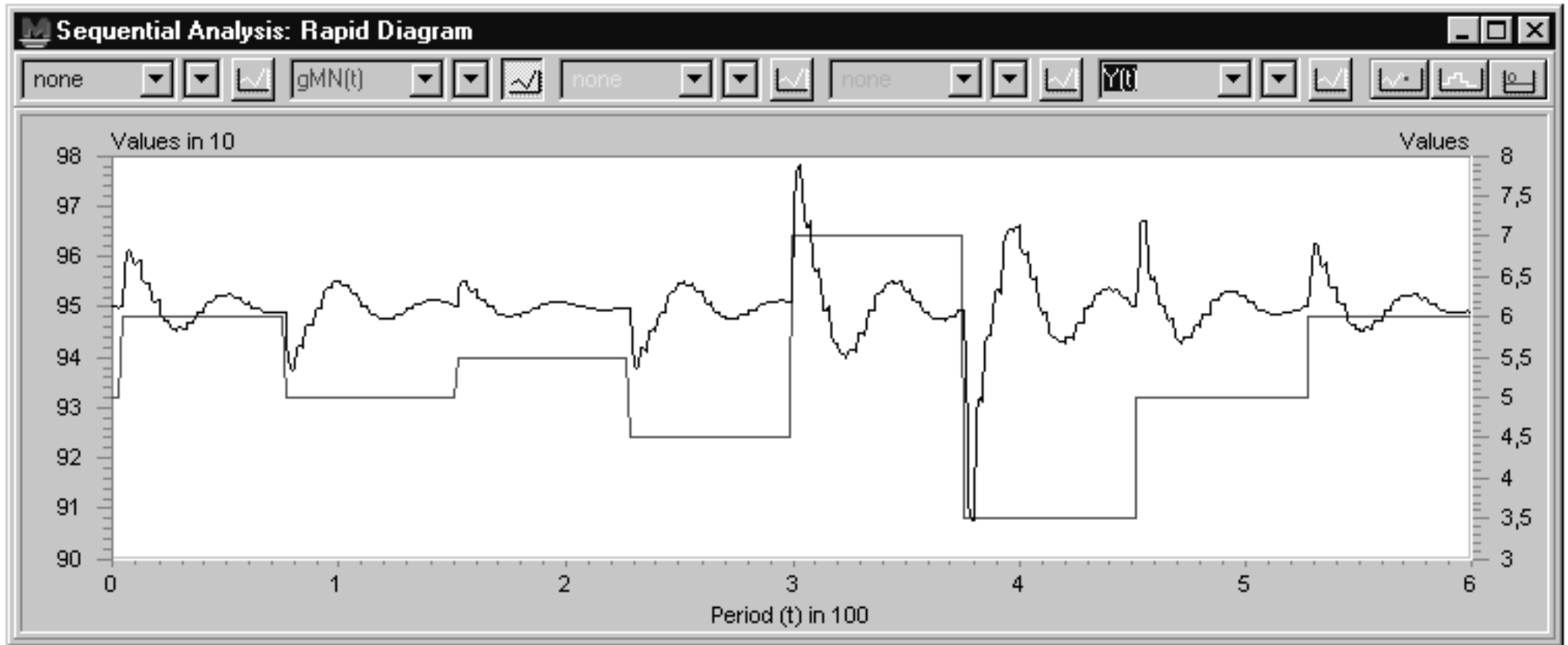
Apply Rules  Learning

2nd recal-culation









MAKROMAT-nfx: Attendant Material for CEF-Contribution, Boston 99 - Microsoft Internet Explorer

File Edit View Go Favorites Help

Address <http://www.wiwi.uni-muenster.de/~09/makromat/cef99/index.htm>

Dr. Stefan Kooths

## MAKROMAT-nfx: Attendant Material for CEF-Contribution, Boston 99

- ▶ **Conference**  
Title: [Computing in Economics and Finance - Fifth Conference of the Society for Computational Economics](#)  
Session: [10.3, 6/26/99, 09:30-10:45 Fulton 145 \(Genetic Algorithms II\)](#)
- ▶ **Paper**  
Title: [Modelling Rule- and Experience-Based Expectations Using Neuro-Fuzzy Systems](#)  
Download: [cef99-kooths.pdf](#) (preliminary version 05/03/99)
- ▶ **Software** (Beta-Release for Microsoft Windows NT 4.0 and 98)  
Setup Disk-Set: [disk1](#) [disk2](#) [disk3](#) [disk4](#) [disk5](#)  
All-in-one Setup: [setup.exe](#)
- ▶ **Models and Rule Bases**  
Model 1: [demo-nfx1 \(adaptive\).mm5](#)  
Model 2: [demo-nfx1 \(rational\).mm5](#)  
Rule Base 1: [demo-nfx1 \(gP, two-dimensional\).nfx](#)  
Rule Base 2: [demo-nfx1 \(gP, rational, 3 terms\).nfx](#)  
Rule Base 3: [demo-nfx1 \(gP, rational, 5 terms\).nfx](#)

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