Controlling Employment, Profitability and Proved Non-Renewable Reserves in Theoretical Model of U.S. Economy

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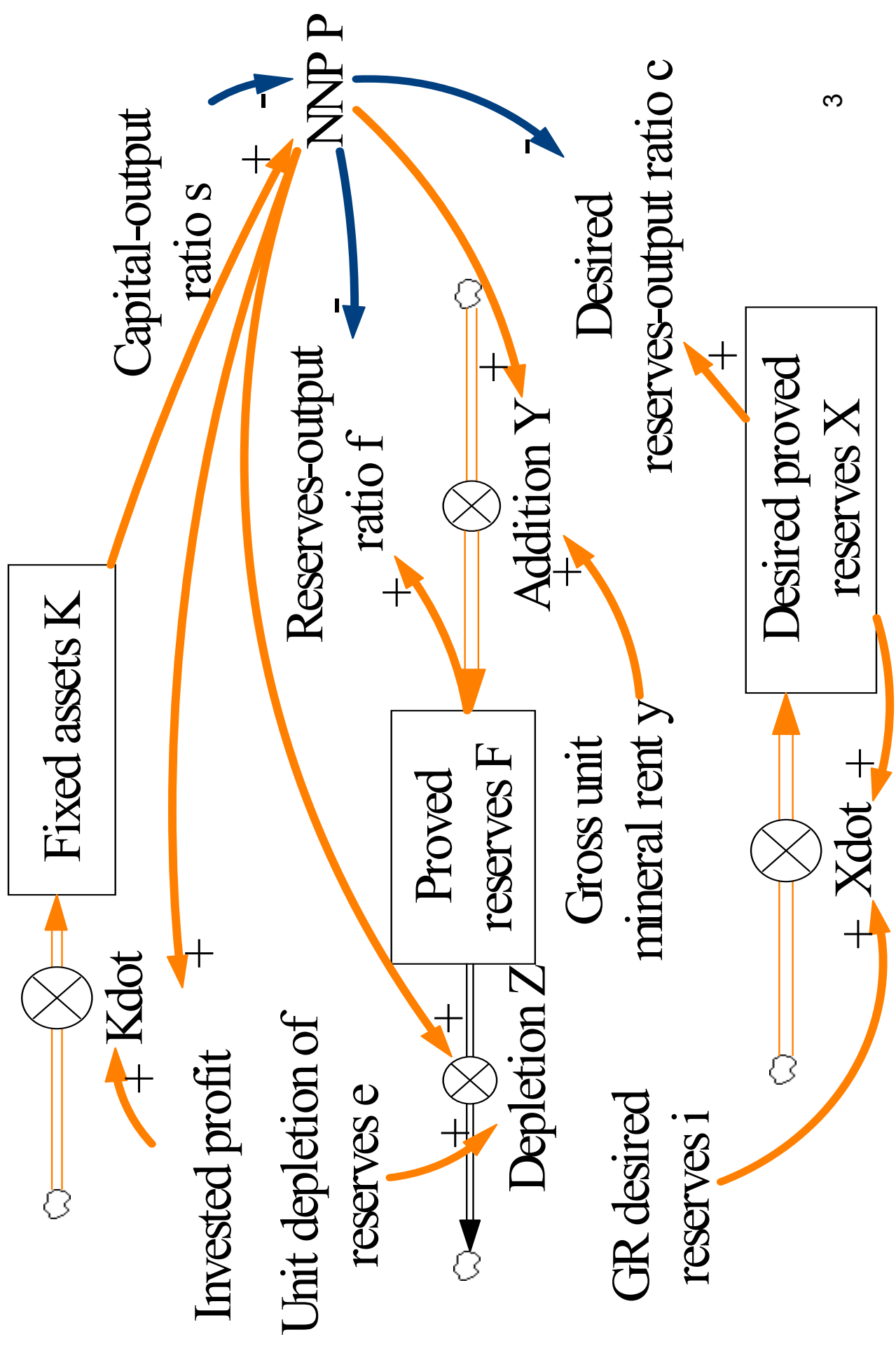17 Academician Lavrentiev Avenue

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Main points

- Strengthening SD paradigm necessitates building its solid core (Forrester, 1983).

- Adherence to this core building motivated a theoretical law of capital accumulation constrained by natural capital (Ryzhenkov 2000–2003).

- Application of Vensim version of extended Kalman filtering to U.S. macroeconomic data 1958–1991 identified unobservable components of this law.

- This paper elaborates this law that (in its initial and transformed form) gives birth to 3 scenarios of U.S. macroeconomic evolution in 1991-2107.

Economy basal stocks and flows (except labour)

Fixed assets K

Kdot

Invested profit

Capital-output ratio s

NNP P

Reserves-output ratio f

Proved reserves F

Unit depletion of reserves e

Depletion Z

Gross unit mineral rent y

Addition Y

Desired reserves-output ratio c

Desired proved reserves X

Xdot

GR desired reserves i

3

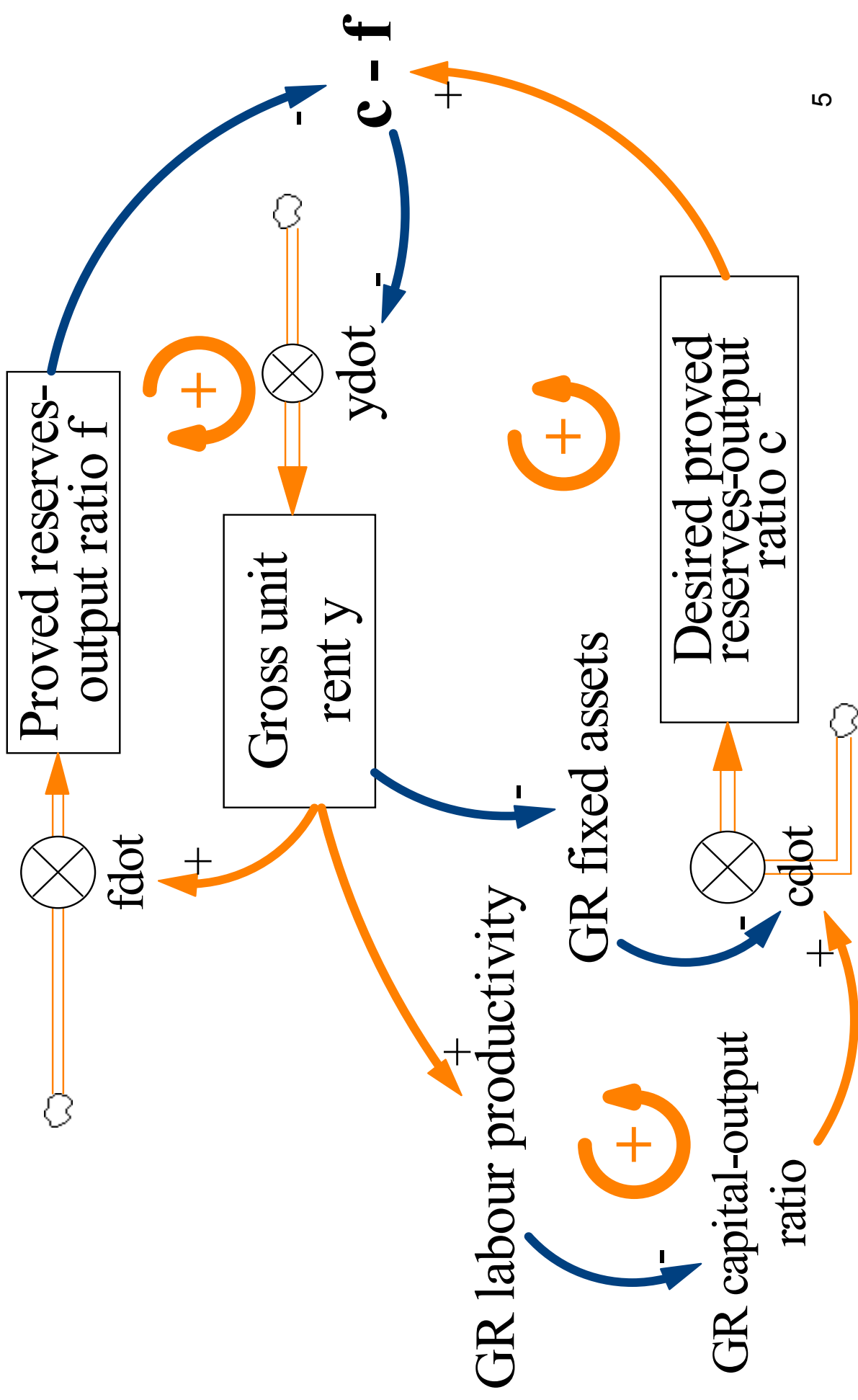# Gross unit mineral rent

$$y = Y / P,$$

$$\dot{y} = [o_1(c - f) + o_2 \hat{f}]y,$$

$$o_2 < 0.$$

Inertia $o_1 < 0$;

Normative I & II $o_1 > 0$.
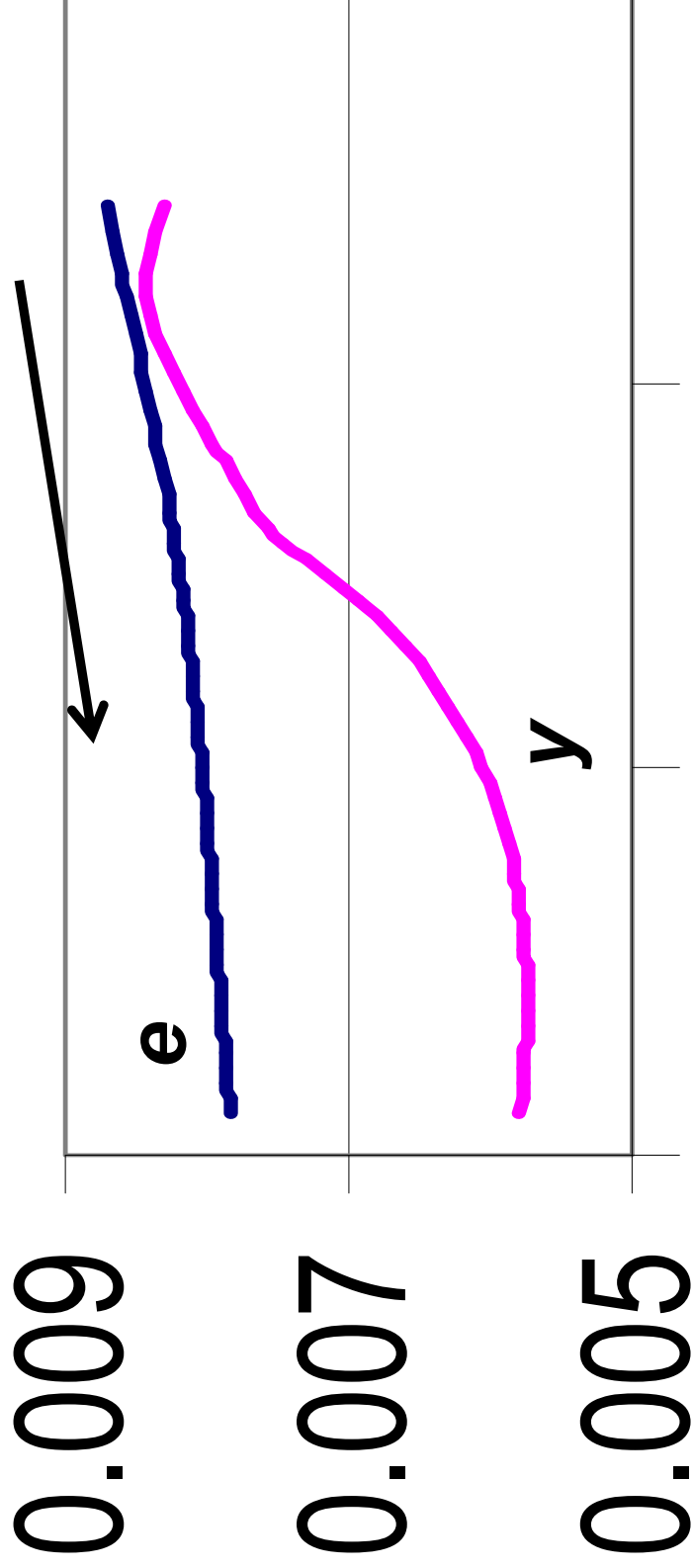
Discrepancy possibly fostering mineral import

Proved reserves-output ratio f

Gross unit rent y

Desired proved reserves-output ratio c

c – f

ydot

fdot

cdot

GR labour productivity

GR fixed assets

GR capital-output ratio

5

Example of knock off-balance increasing returns
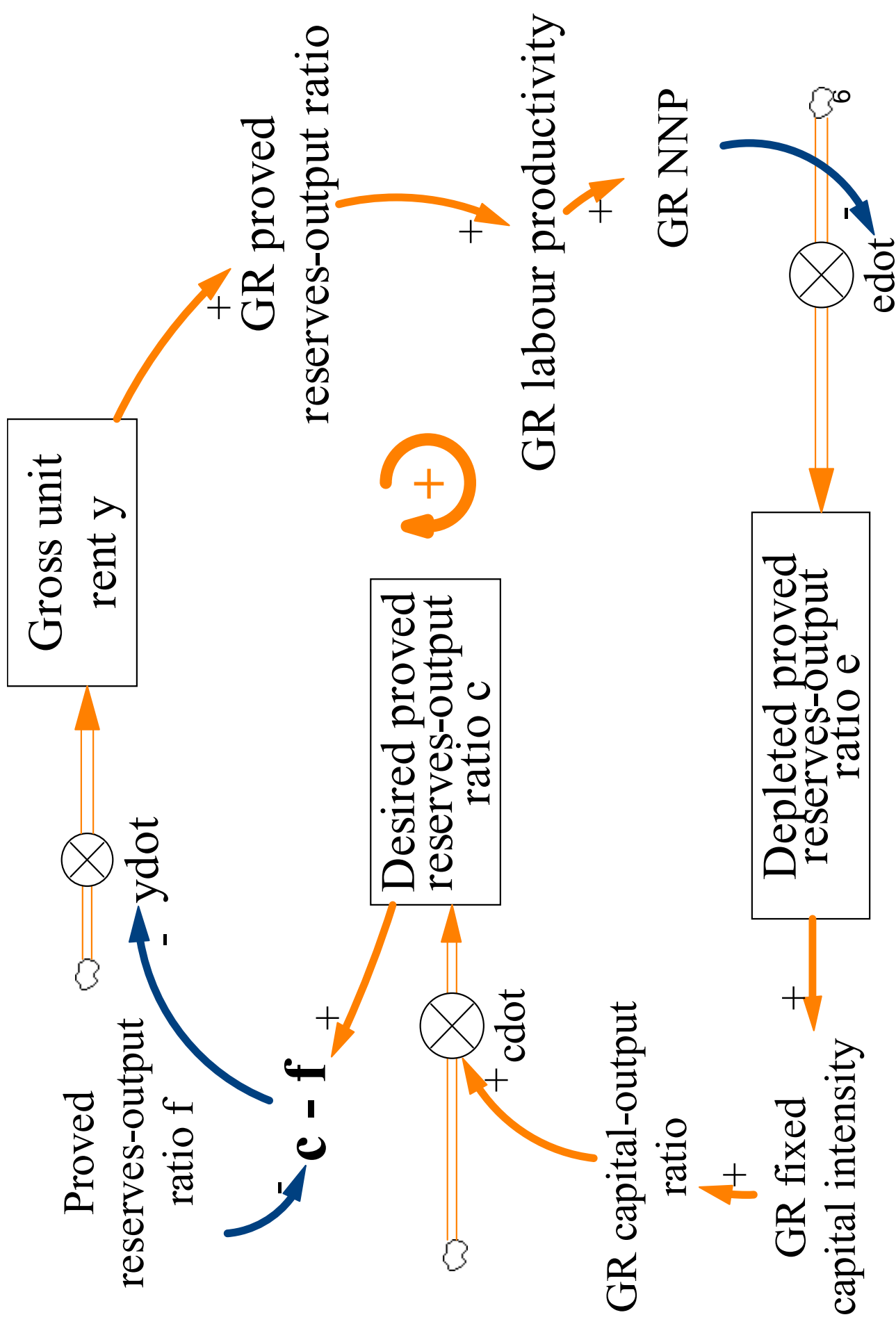
Analogues of *f* vs *e*, *y* for crude oil, 1991-2005

unit depletion of proved reserves *e*

gross unit rent *y*

Proved reserves/real GDP

f
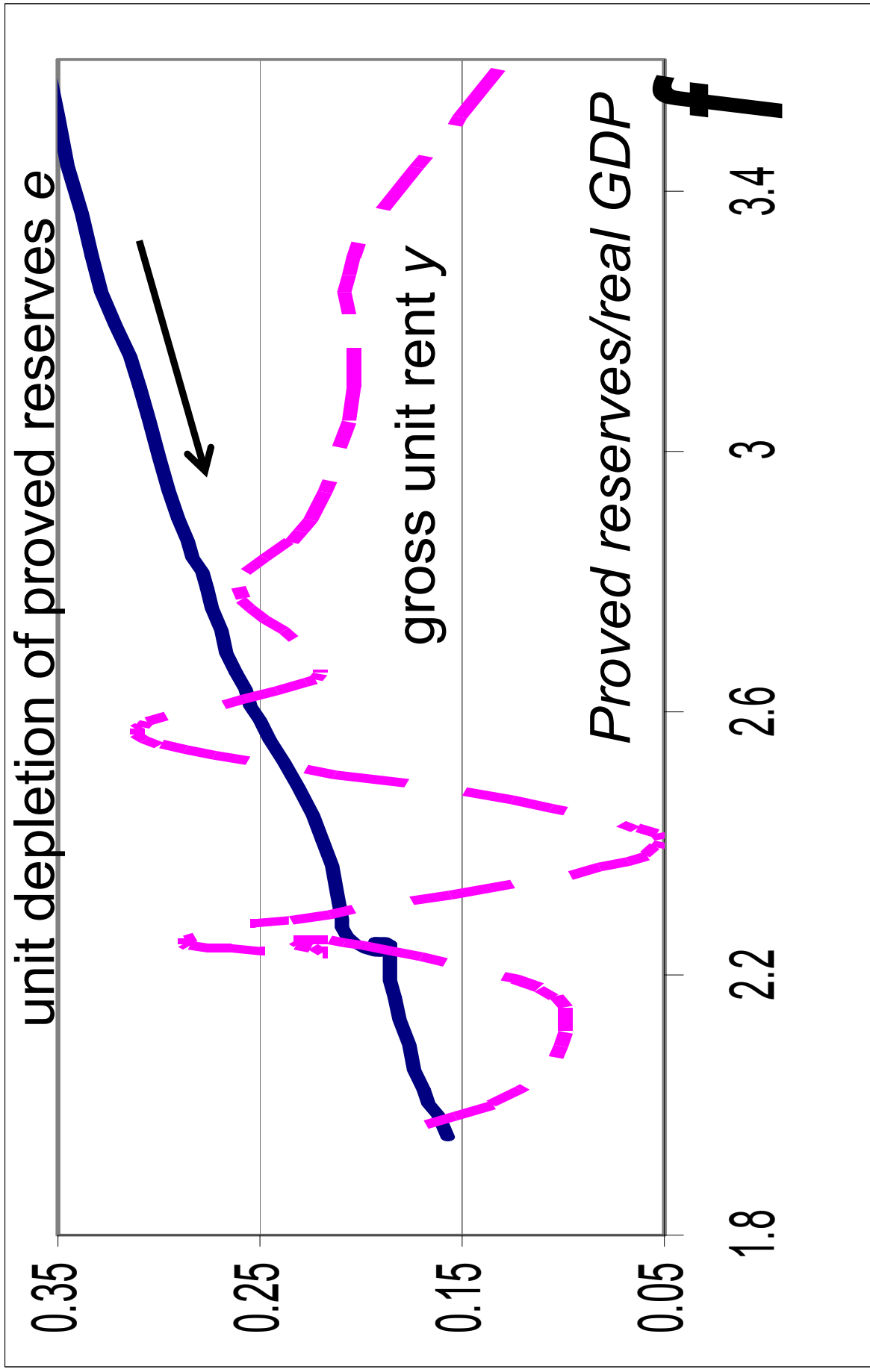
Inertia scenario, 1991-2005

e

y

f

0.06 0.08 0.1 0.12

0.005 0.007 0.009

Inertia scenario, semi-log scale, 1991-2005

Desired proved reserves-output ratio

Proved reserves-output ratio

log(c), log(f)
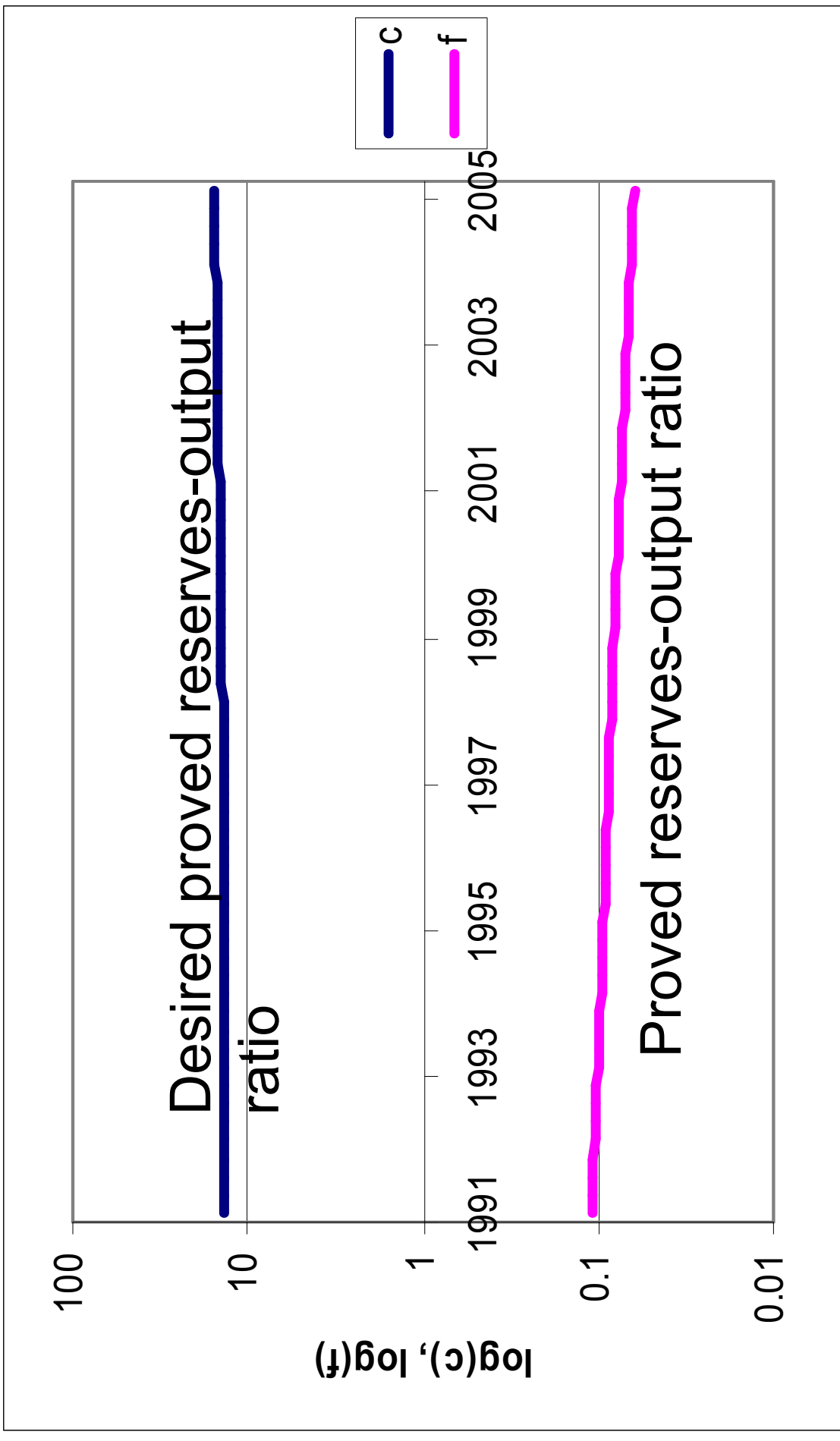
Inertia scenario, 1991-2107:
Falling Rate of Capital Accumulation

stationary average profit rate d/k

average profit rate

net rent rate

0.2   0.1   0   -0.1

1991 2000 2002 2013 2024 2035 2046 2057 2068 2079 2090 2101
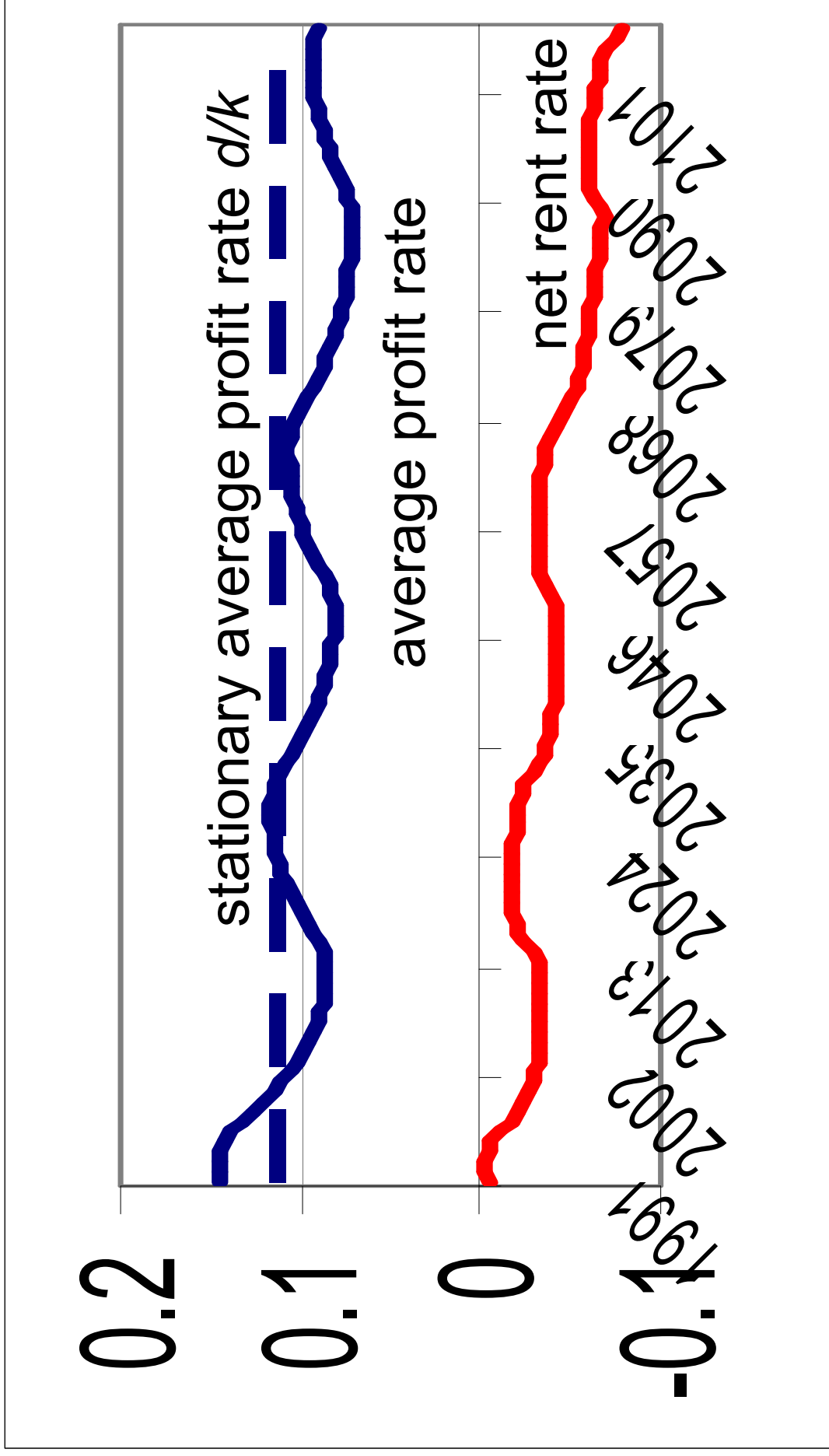
Inertia scenario: employment ratio, 1991–2107

stationary employment ratio

employment ratio

Legend: v, v eq

y-axis: 1, 0.94, 0.88

x-axis: 1991, 2002, 2013, 2024, 2035, 2046, 2057, 2068, 2079, 2090, 2101
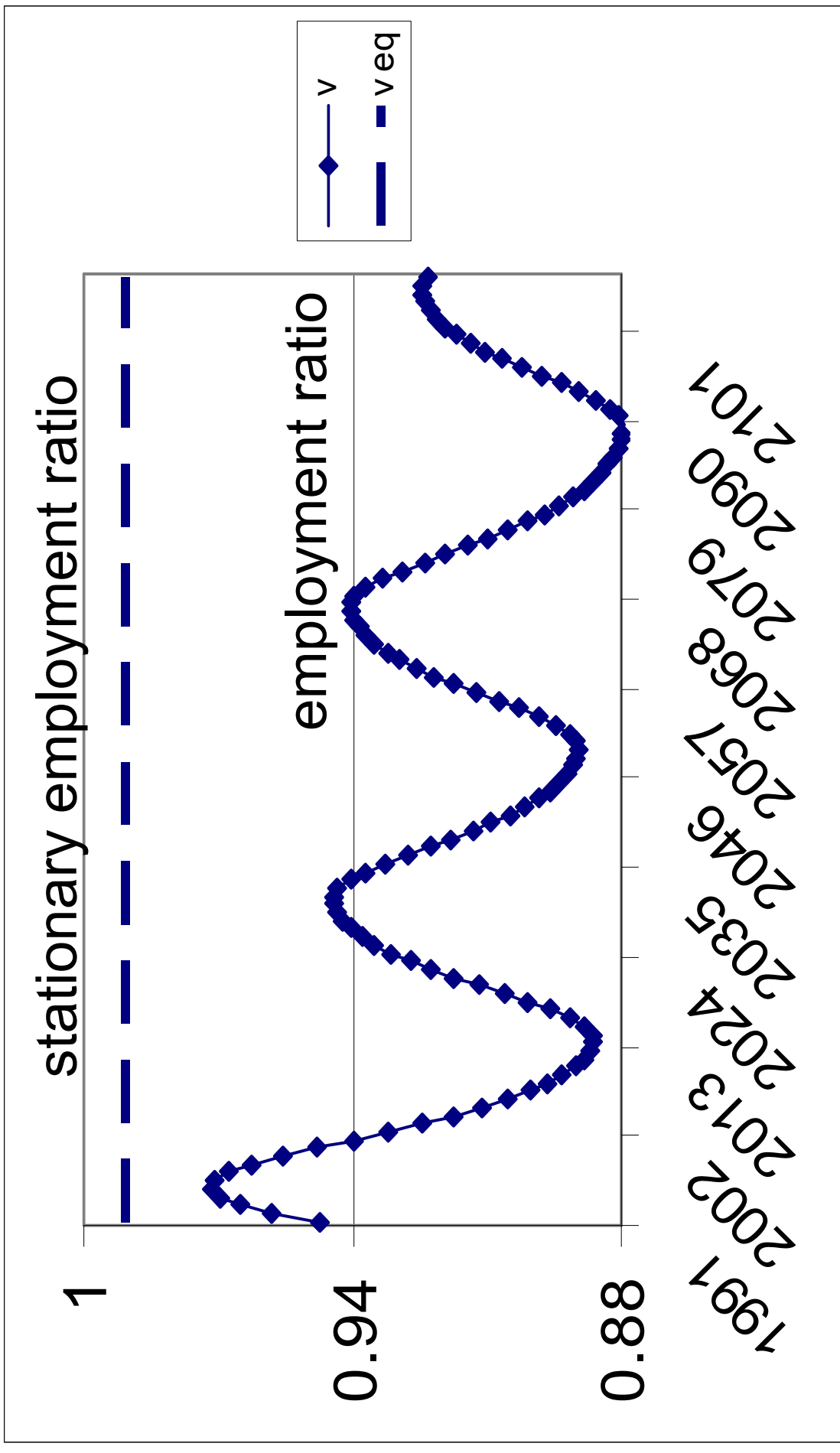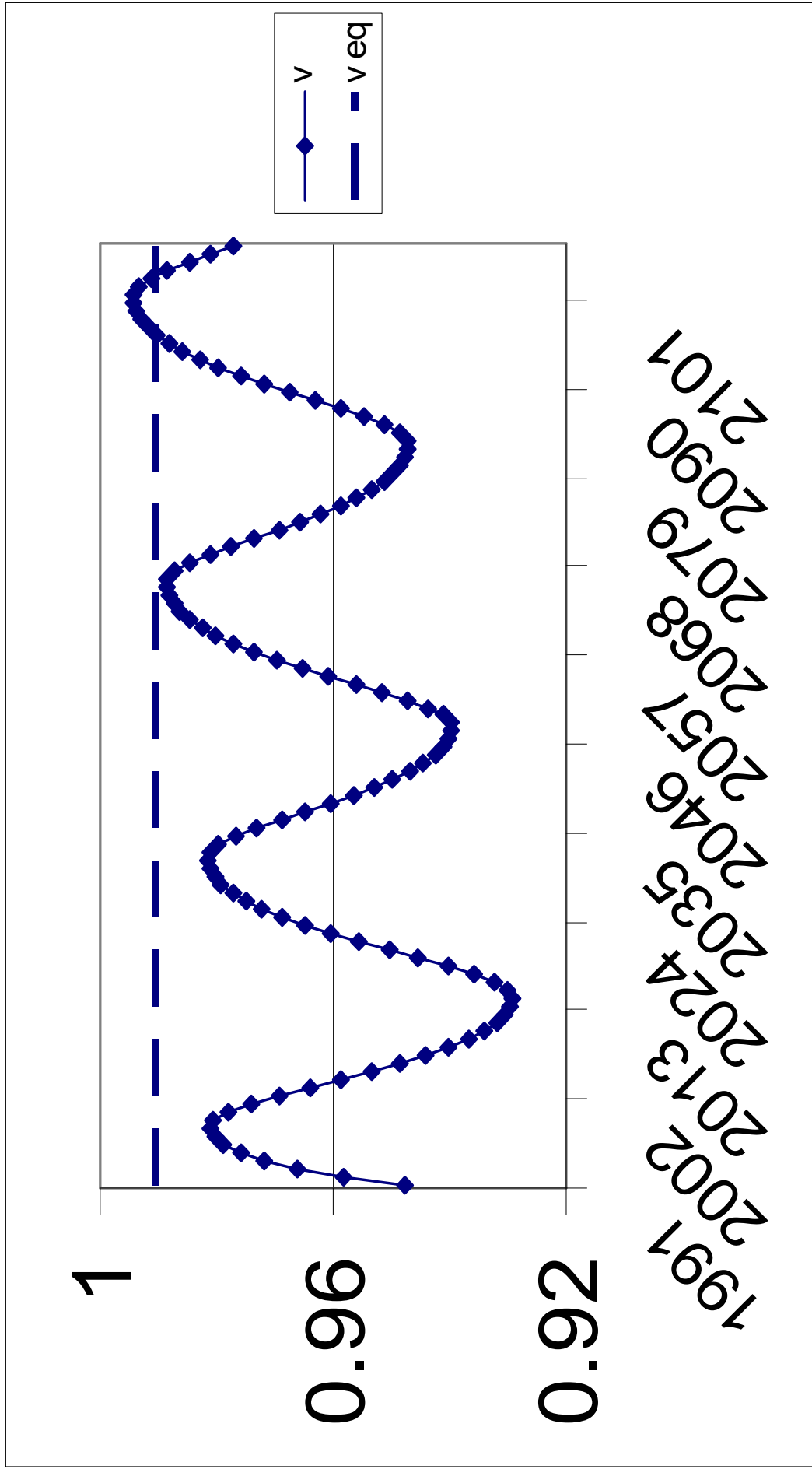
Normative scenario I

- 0.35 per cent of the net output is invested additionally in extension of proved reserves on the average in 1991–2107 in relation to the inertia scenario;

- growth rates of labour productivity and net output rate are increased;

- proved mineral reserves instead of been excessively depleted are extended;

- secular fall in average profit rate is moderated;

- gains in employment ratio and in growth rate of real labour compensation.

Normative scenario I: average profit rate and net rent rate, 1991-2107

average profit rate

stationary average profit rate d/k

net rent rate

stationary net rent rate d

0.15

0.09

0.03

-0.03

1991 2003 2015 2027 2039 2051 2063 2075 2087 2099
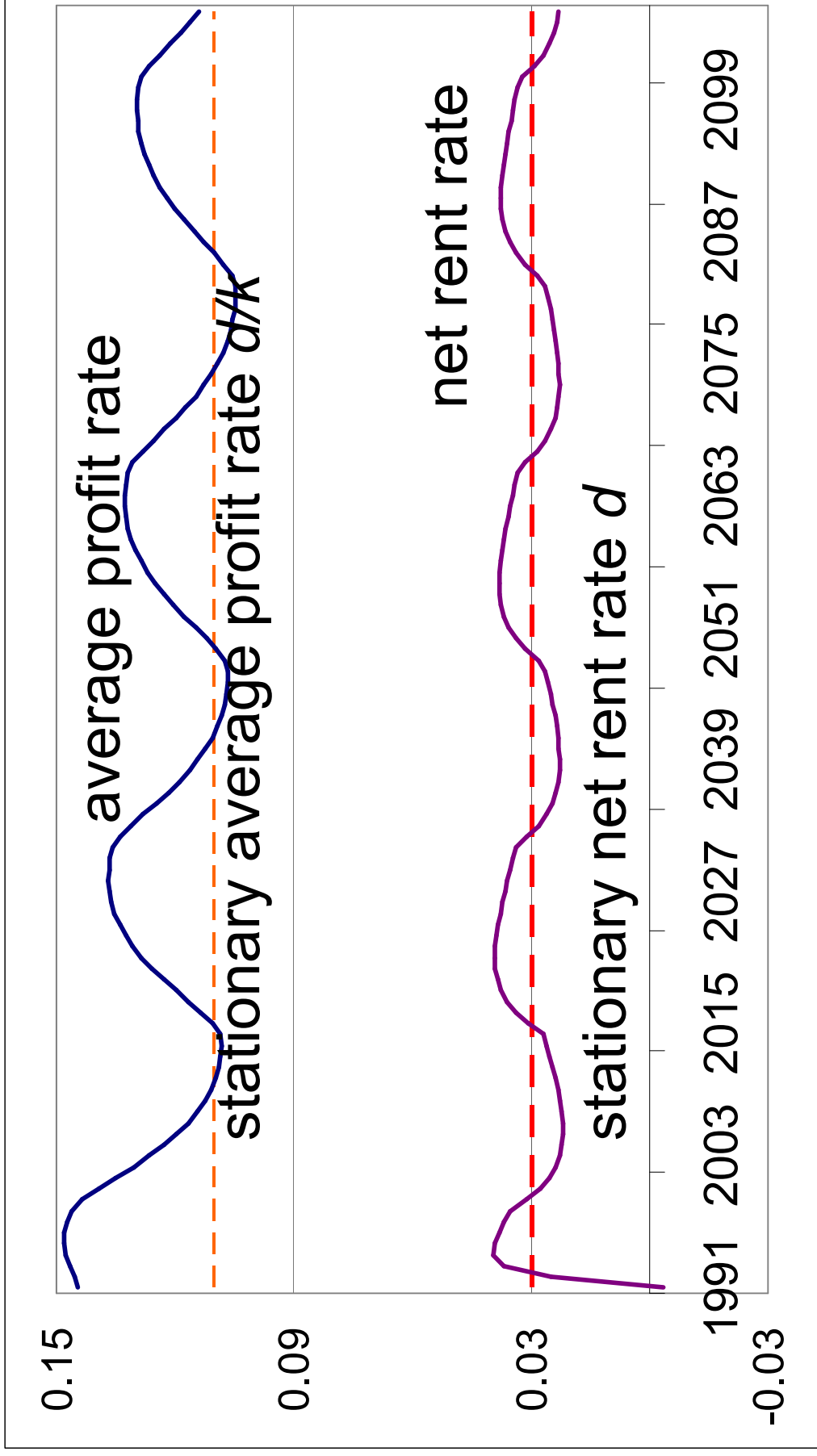
Employment ratio versus its stationary magnitude in normative scenario I, 1991–2107

Legend: v, v eq

Normative scenario II: overt closed-loop control over employment and profitability

- Profit is the decisive factor of big economic cycles under capitalism and could be the key for smoothing them.

- The state can levy surcharges on excessive income of labourers (or capitalists) and pay equivalent subsidies to capitalists (or labourers).

- The levy year and base are sliding.

Target growth rate of total profit

$$\hat{M} = -\frac{\dot{u} + \dot{y}}{1 - u - y} + \hat{P} = o_3(\widetilde{v} - v), \quad o_3 > 0.$$

Target employment ratio $v_b = \widetilde{v} - d / o_3,$

d is stationary NNP growth rate.

Post-levy growth rate of compensation

$$\hat{w} = \hat{u} + \hat{a} = (\hat{P} - \hat{M})\frac{1 - u - y}{u} - \frac{\dot{y}}{u} + \hat{a}.$$

Growth rate of pre-levy labour compensation

$$\hat{w}_{pt} = -g + rv + bK\hat{}/L + qF\hat{}/L, \quad g > 0, \ r > 0,$$

$$q < 0.$$

Rate of excess labour compensation levy as a fraction of unit

$$x_w = \left(\hat{w}_{pt} - \hat{w}\right) \cdot 1[\text{year}].$$

Excess labour compensation levy equals subsidy on primary profit

$$T_w = x_w wL = S_P.$$

Stationary excess income levy rates

Relative excess labour compensation levy

$$\bar{x}_w = r(v_b - v_a) \cdot 1[\text{year}] = -0.0018,$$

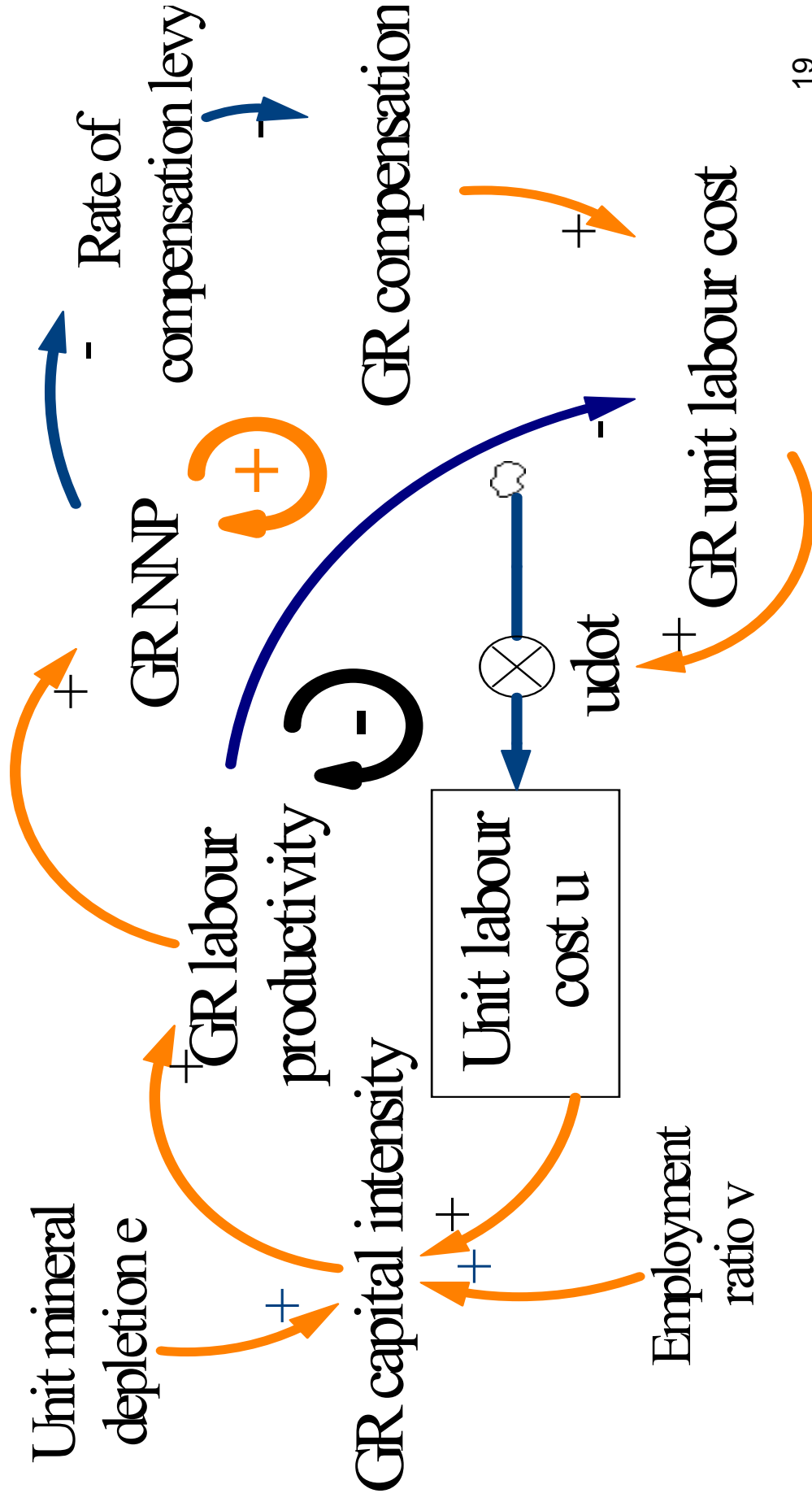where $v_b = 0.96$ is Target, $v_a = 0.99$ is Inertia stationary employment ratios, $r = 0.06$.

Share of excess labour compensation levy in net output $\bar{x}_P = \bar{x}_w u_b = -0.0012$.

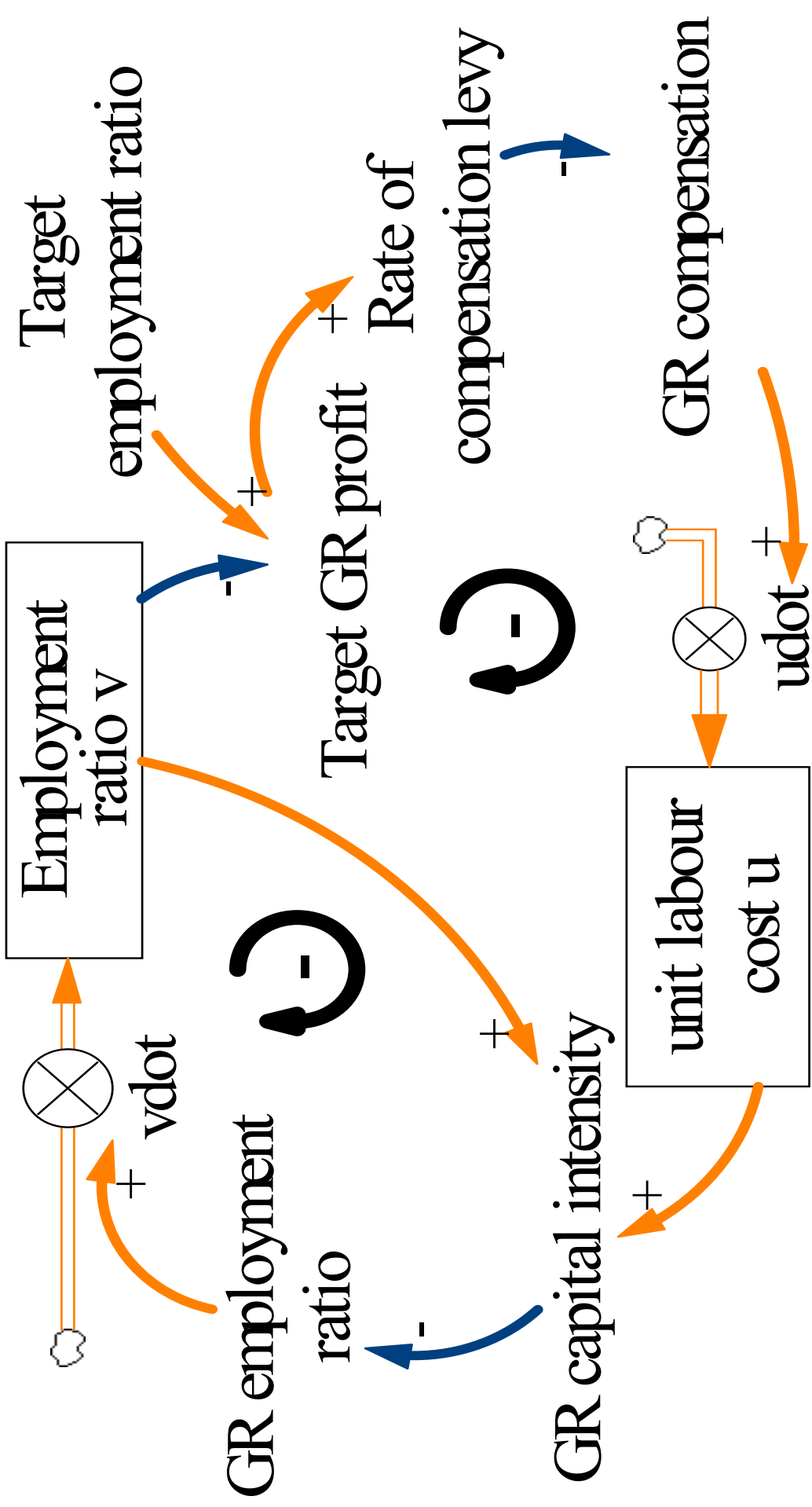## Relative subsidy on primary profit

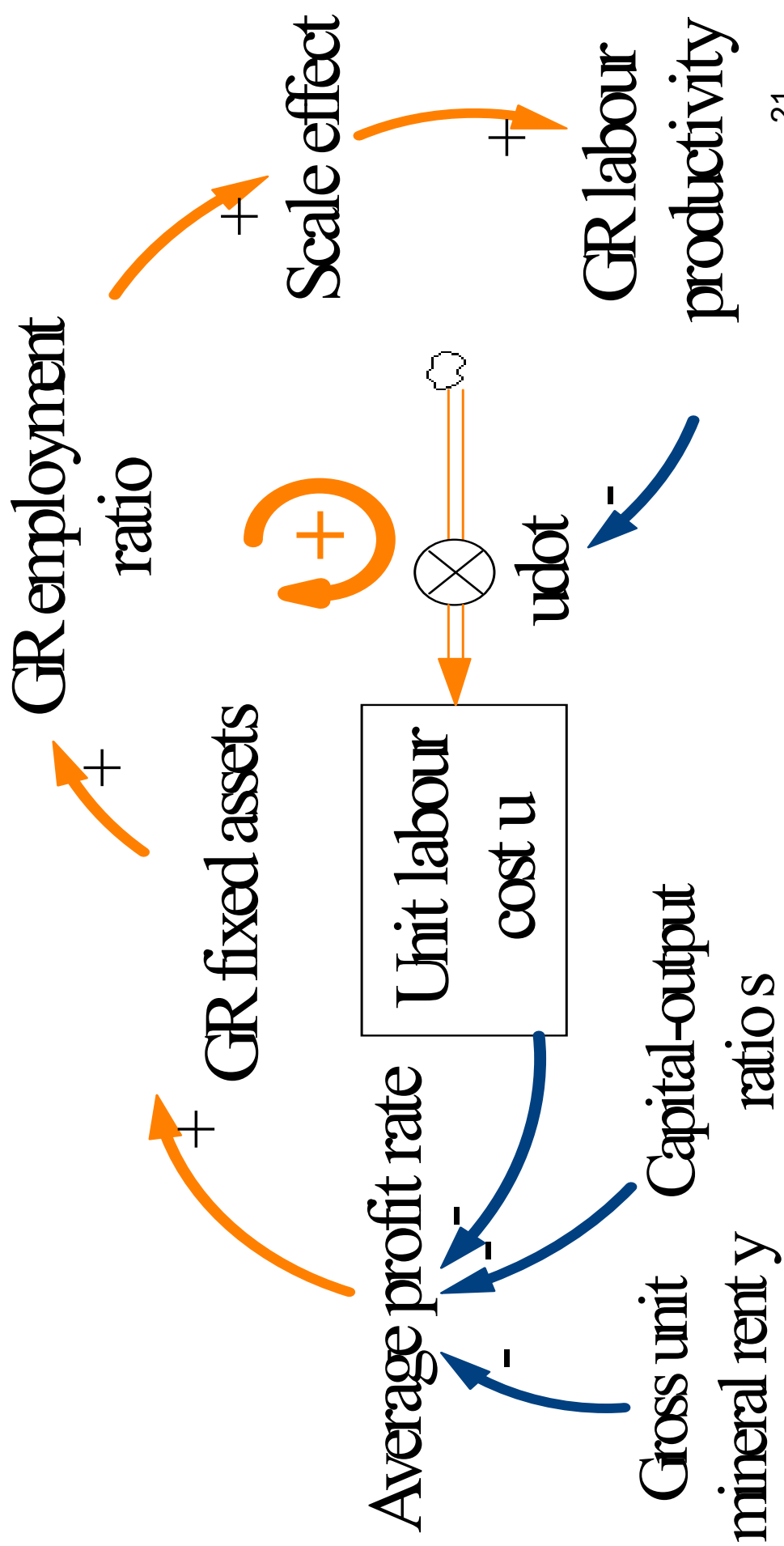$$\bar{x}_M = \bar{x}_w u_b / (1 - u_b - y_b) = -0.0042.$$

1st order negative and positive feedback loops controlling labour cost (1st counter-neoclassical example of increasing returns)

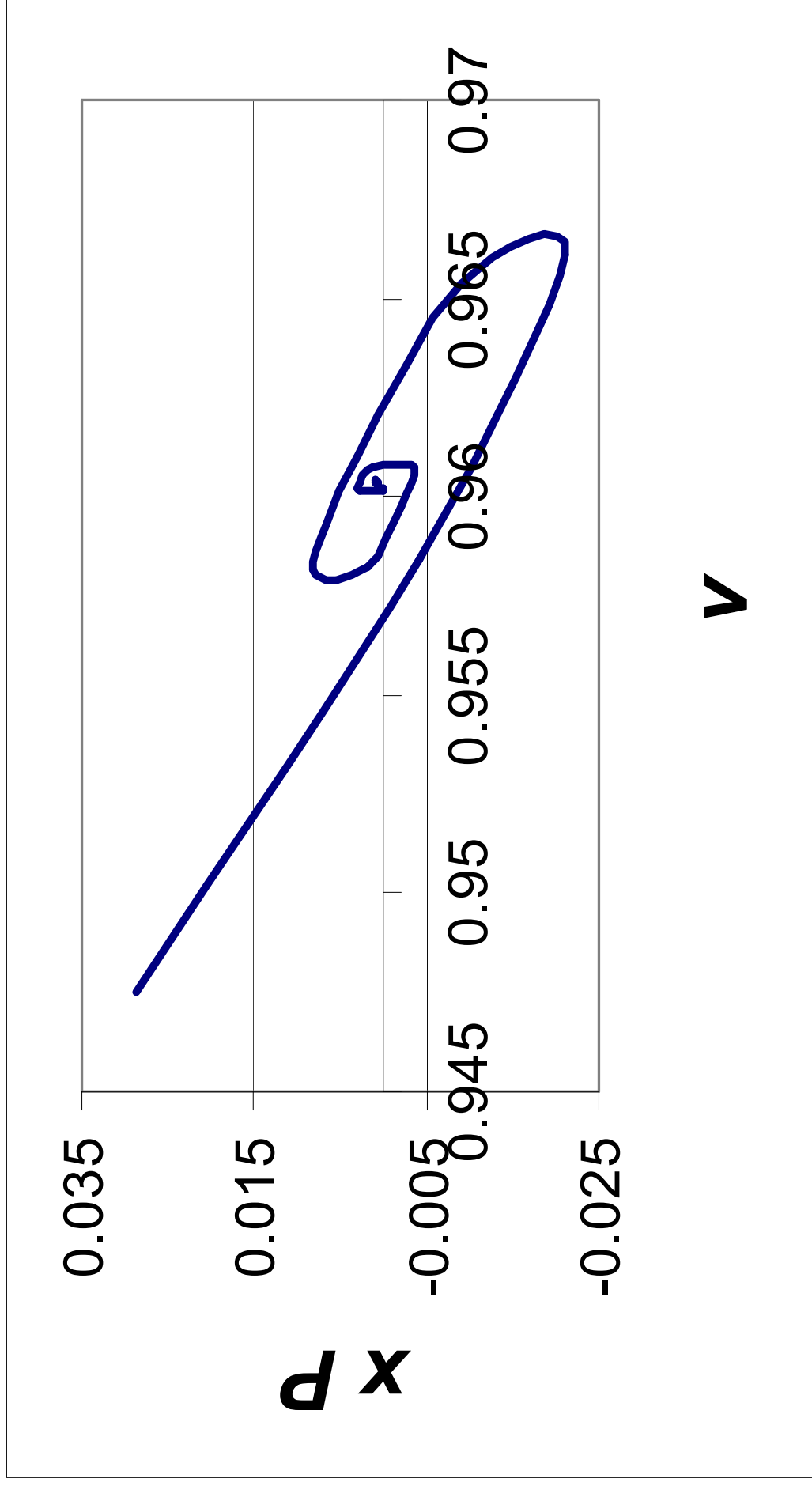Rate of compensation levy

GR compensation

GR unit labour cost

GR NNP

GR labour productivity

udot

Unit labour cost u

GR capital intensity

Unit mineral depletion e

Employment ratio v

1st and 2nd order negative feedback loops controlling employment ratio and labour cost

Target employment ratio

Rate of compensation levy

Target GR profit

Employment ratio v

unit labour cost u

GR compensation

udot

GR employment ratio

vdot

GR capital intensity

Increasing returns in 1st order positive feedback loop
controlling labour cost (2nd counter-neoclassical example)

Scale effect

+

GR labour
productivity

+

GR employment
ratio

+

udot

−

+

⊗

GR fixed assets

Unit labour
cost u

+

Average profit rate

−

−

−

Capital-output
ratio s

Gross unit
mineral rent y

Normative scenario II: unit excess income levy (x_P)
against employment ratio (v), 1991–2018

Normative scenario II, 1991–2107

- 0.35 per cent of net output is invested additionally in extension of proved reserves on the average versus inertia scenario;

- proved mineral reserves instead of been excessively depleted are extended;

- growth rates of labour productivity and compensation are increased in relation to previous scenarios;

- secular fall in average profit rate is moderated;
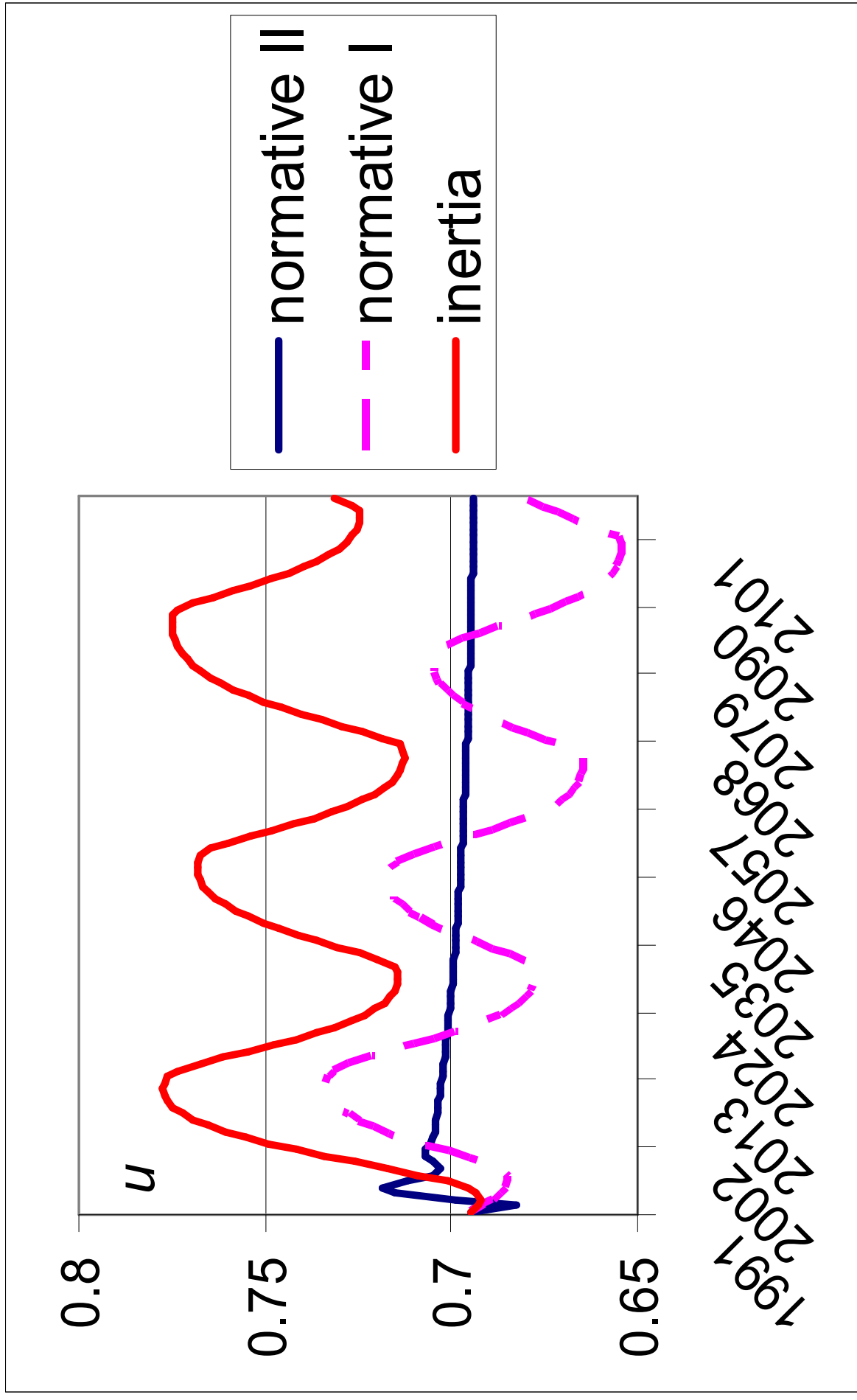
- Long waves cease to exist.
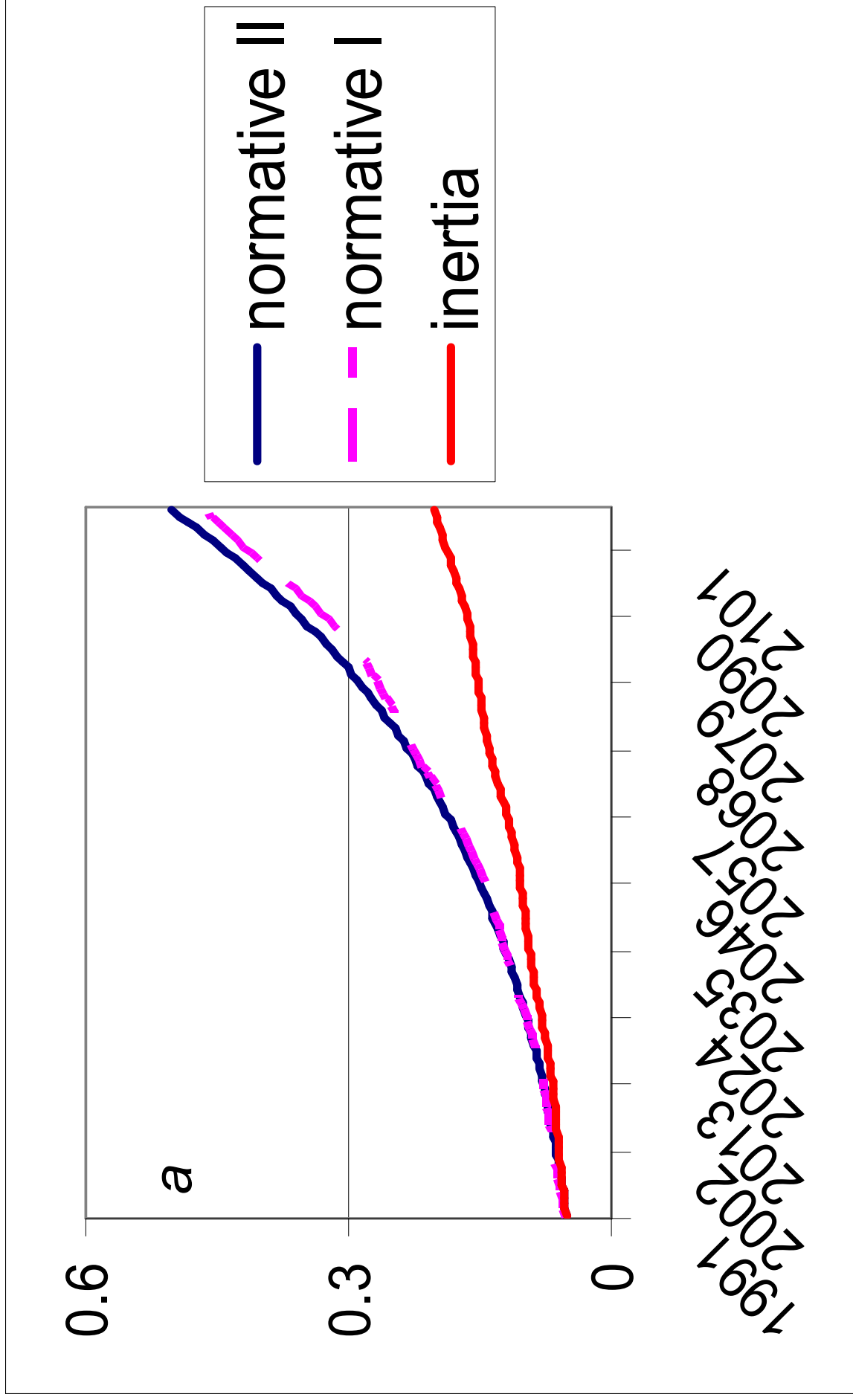
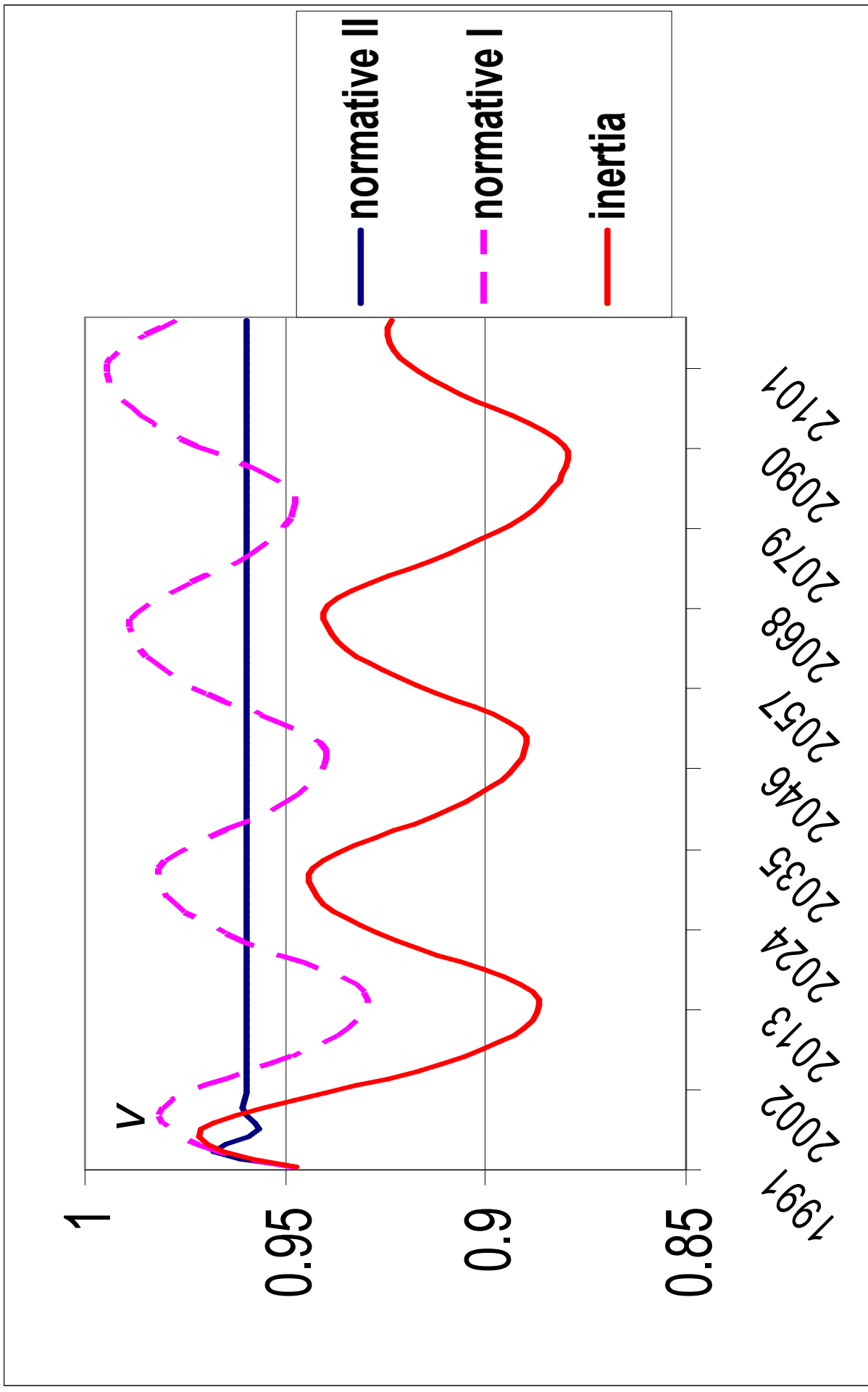Average profit rate in three scenarios, 1991–2107

- normative II
- normative I
- inertia I

Compensation in three scenarios, 1991–2107

Legend:
- normative II
- normative I
- inertia
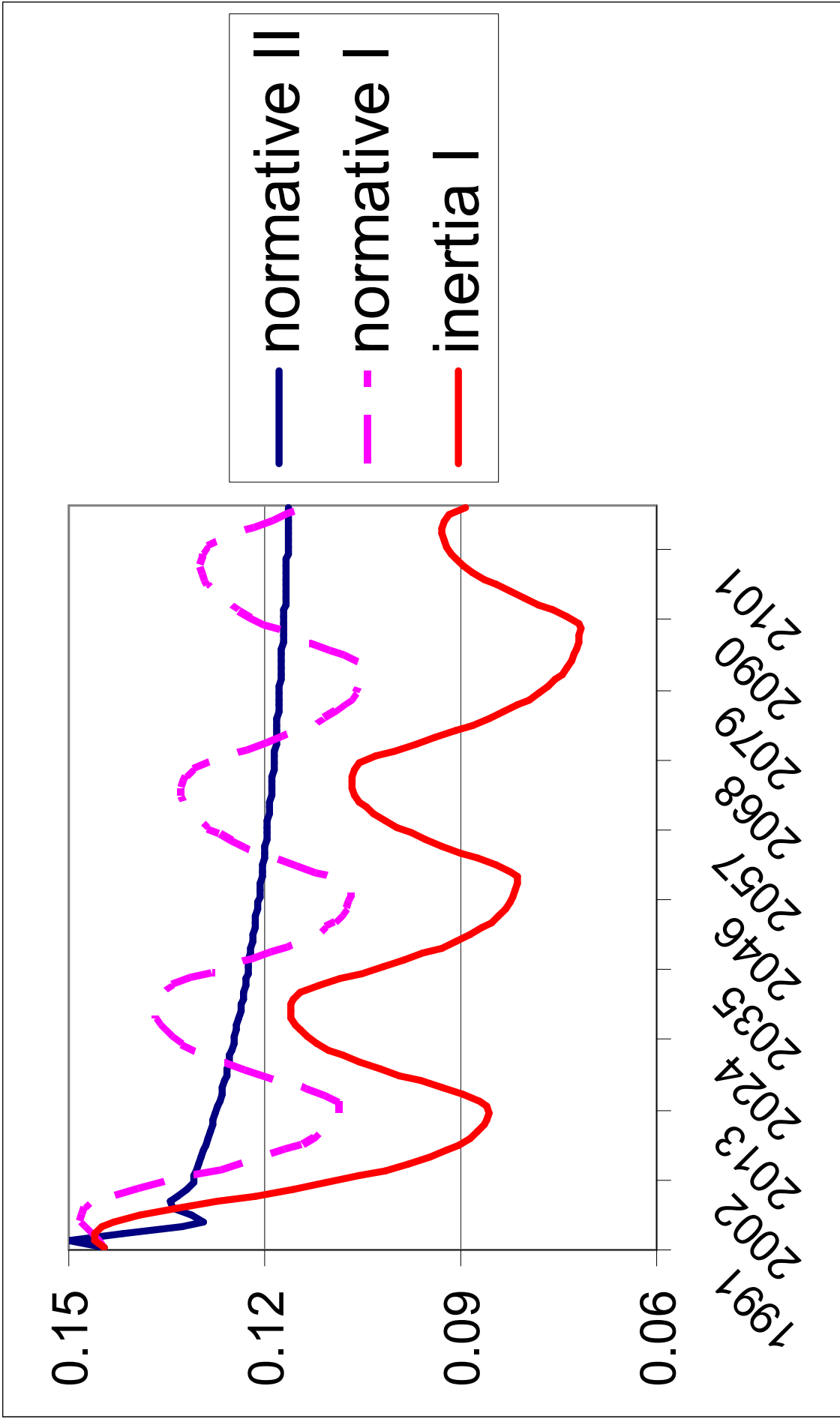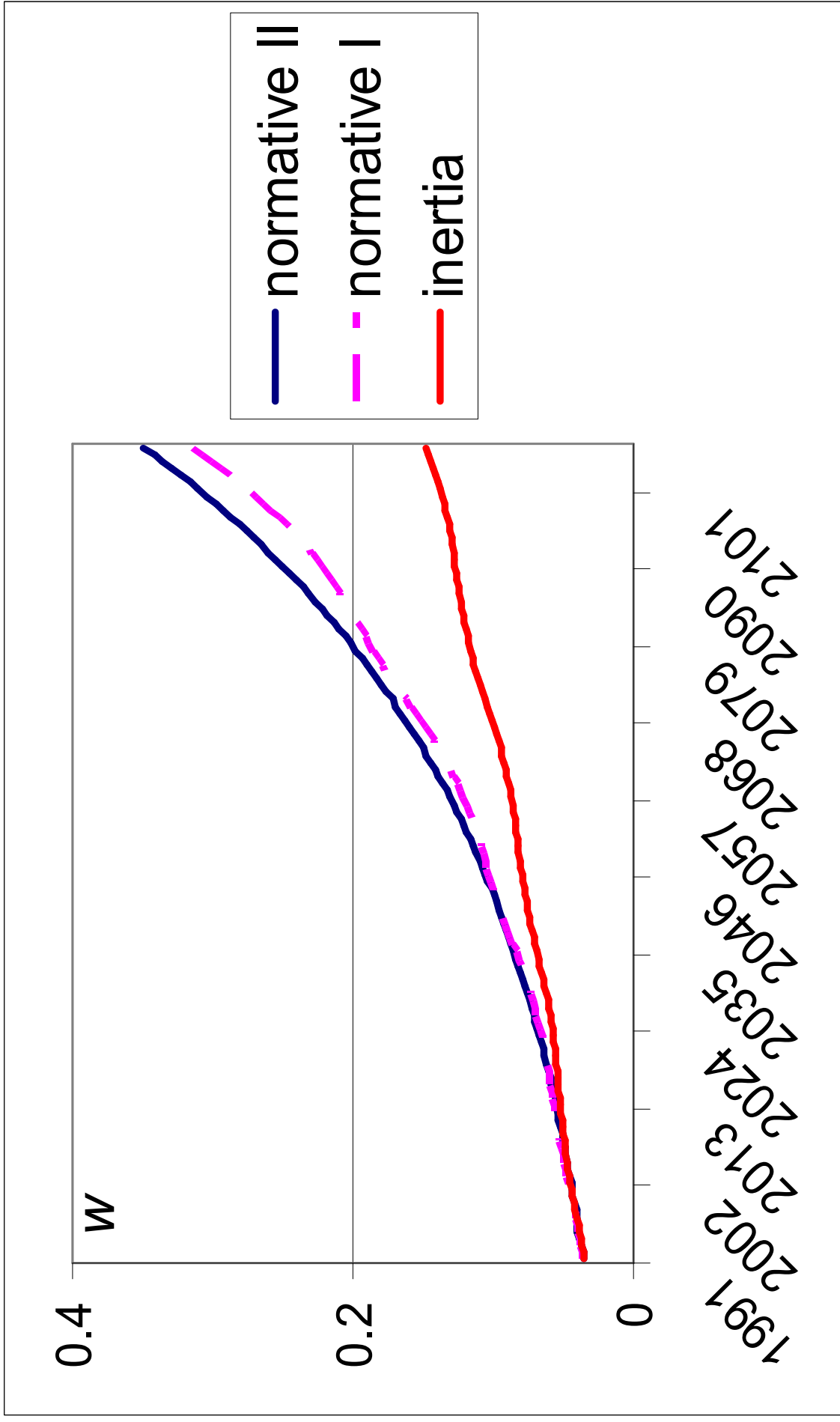
Relative compensation in three scenarios, 1991–2107

Productivity in the three scenarios, 1991–2107

Legend:
- normative II
- normative I
- inertia

Employment ratio in three scenarios, 1991–2107

Legend: normative II, normative I, inertia

X-axis: 1991 2002 2013 2024 2035 2046 2057 2068 2079 2090 2101

Y-axis: 1 0.95 0.9 0.85

Gross unit rent in three scenarios, 1991–2107
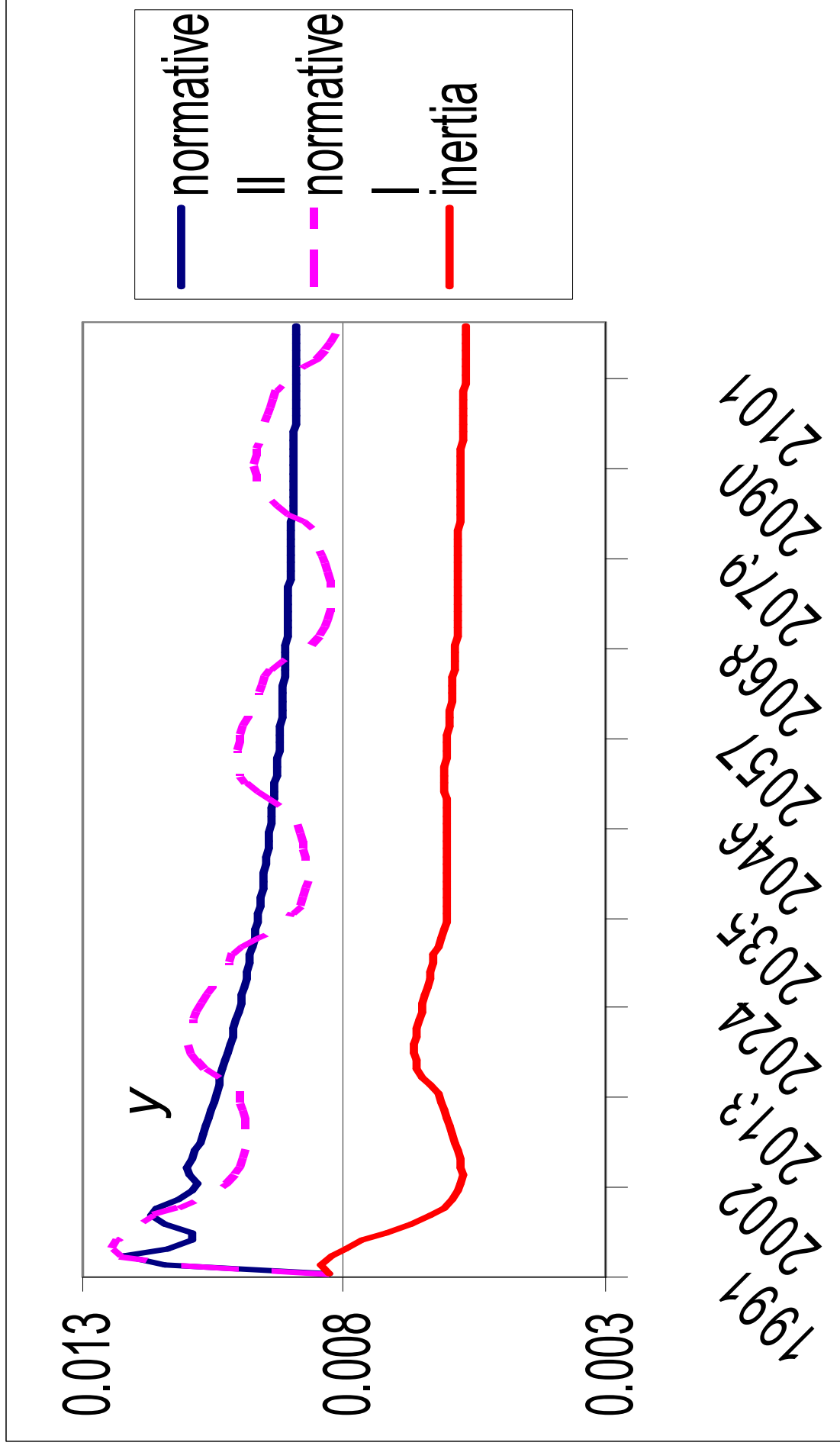
Conclusion

- strengthening conscious societal control over proved mineral reserves facilitates sustainable development;

- enhanced overt closed-loop control over total profit and employment could bring substantial additional social gain;

- in particular, there are realistic opportunities for lessening substantial dynamic inefficiency in modern capitalism via excess income levy by the state;

- contrary to typical neoclassical macro-economic models, increasing returns (positive feedback loops) may foster pro-growth stabilization of the U.S. economy.